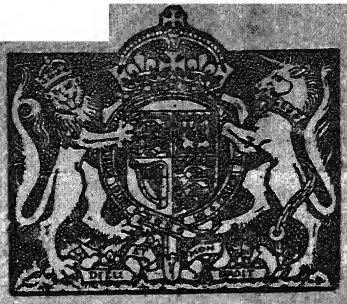

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HANDBOOK

FOR THE

ORDNANCE, Q.F. 25-PR., MARKS II AND III

ON

CARRIAGE, 25-PR. MARK I

AND

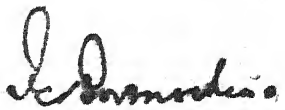
MOUNTING, S.P. 25-PR., C MARK I

AND

MOUNTING, VALENTINE, 25-PR., GUN, MARK I

LAND SERVICE
1944

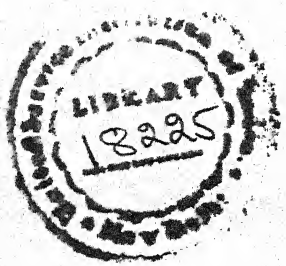
By Command of the Army Council,



THE WAR OFFICE,
29th August, 1944.

AMENDMENTS.

Amendment Serial Number	Army Council Instruction	By whom amended	Date of insertion



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NOTE.—This book has been corrected up to August, 1944. Any alterations that may be suggested should be forwarded to the Inspector General of Armaments.

LIST OF INSTRUCTIONAL WALL DIAGRAMS FOR THIS EQUIPMENT

Equipment diagrams

Demands to be made on the Commandant, C.O.D., Donnington, near Wellington, Salop, on a scale of one set for each troop.

No.	Description	Remarks
	Ordnance, Mark II—	
E.838	Breech mechanism	
E.810	Construction	
	Carriage, Mark I—	
E.829	Lubrication chart	
E.830	General arrangement	
E.839	Recoil system	
E.1133	Elevating gear	
E.1134	Traversing gear	
E.673	Trailer, No. 27, Mark I	
E.850	Lubrication chart	
E.658	Sights, dial, No. 7 and 7A	
E.837	Carrier, No. 7 to 7C dial sight, No. 18, Mark I	

Ammunition diagrams

Demands to be made on the Commandant, C.A.D., Bramley, on a scale of one set for each troop.

No.	Description	Remarks
E.326	Primer, percussion, Q.F. cartridge, No. 1, Mark II and IIM	
E.455	Primer, percussion, Q.F. cartridge, No. 11, Mark I	
E.468	Fuze, T and P, No. 220, Mark III	
E.472	Fuze, T and P, No. 221, Mark I	
E.519	Fuze, percn. D.A., No. 117, Mark III	
E.568	Fuze, D.A. and percn., No. 119 (Typical) Mark I	
E.588	Tracer, shell, No. 2, Mark IV	
E.805	Ammunition, Q.F. 25-pr.	
E.809	Cartridge, Q.F. 25-pr.	
E.811	Ammunition, Q.F. 25-pr. (Typical markings)	
E.823	Fuze, time, No. 210, Mark I	
E.852	Ammunition, Q.F. 25-pr., sectional view during flight	
E.1106	Fuze, T and P, No. 222, Mark I	

CHAPTER I

ORDNANCE, Q.F. 25-PR., MARKS II AND III

PARTICULARS

Material	Steel.
Weight estimated—	
With breech mechanism	8 cwt. 3 qrs. 20 lb.
Without breech mechanism	8 cwt. 0 qrs. 6 lb.
Length—	
Total	97·473 inches.
Barrel	92·51 inches.
Bore—	
Calibre	3·45 inches.
Length	92·375 inches.
Capacity (total effective)	896 cubic inches.
Chamber—	
Capacity (total effective)	151 cubic inches.
Driving band design No.	DD(L)6487/2.
Length to base of projectile	14·47 inches.
Ramming	19·568 inches.
Travel of projectile	77·905 inches.
Rifling—	
System	Polygroove, plain section.
Length	74·235 inches.
Twist	Uniform, 1 turn in 20 calibres.
Grooves—	
Number	26.
Depth	0·04 inch.
Width	0·2777 inch.
Firing mechanism	Percussion.
Position of C. of G. from face of breech—	
Without breech mechanism and unloaded	38·58 inches.
Shipping tonnage	14 tons 36·75 cubic feet.

CONSTRUCTION

(Fig. 1)

The **Mark II** gun body consists of a loose barrel, jacket with sealing collar, and a removable breech ring.

The **barrel** is prepared internally with rifling on the polygroove system (plain section), with 26 grooves having a uniform twist of 1 turn in 20 calibres, to impart spin to the projectile, the rear end being plain to receive the brass cartridge case which contains the propellant charge. Externally, at the rear end, a shoulder is

f ormed to position the barrel in the jacket, where it is secured by two securing screws. The muzzle end is screw-threaded externally to receive a muzzle brake, where it is secured against rotation by a set screw.

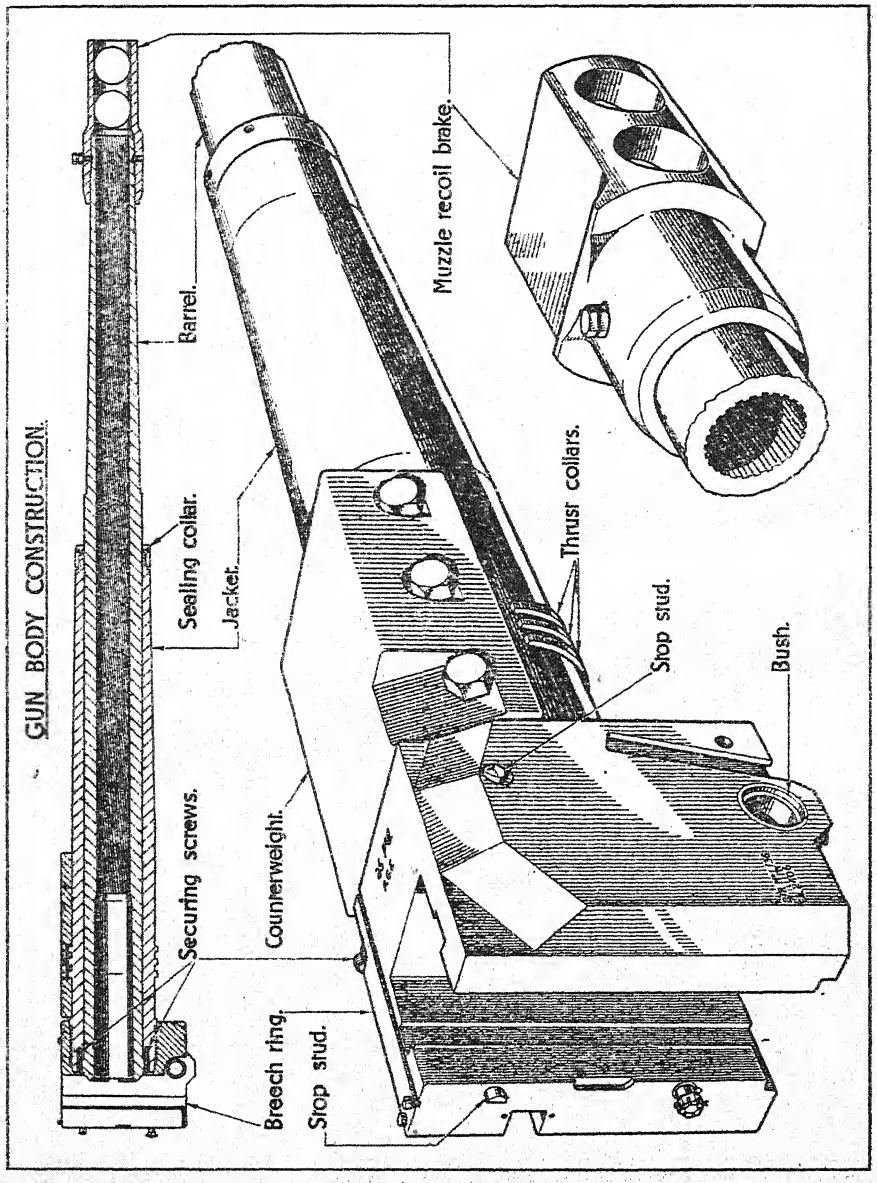

FIG. 1

The **muzzle brake** is fitted over the muzzle end of the gun to stabilize the carriage against the effects of jump.

It consists of a steel casing with set screw and lock nut.

The casing is in the form of a hollow cylinder with two baffle plates, and is screw-threaded internally, at the rear end, to suit the threads on the muzzle end of the barrel. When assembled on the barrel the brake is locked in position by a set screw and lock nut, the screw engaging with a V-shaped recess prepared on the barrel.

Four circular ports are prepared, two in each side of the cylinder. When the projectile reaches the rear baffle plate a certain amount of the propellant gases are allowed to escape through the rear ports. Similar action takes place when the projectile reaches the front baffle. Therefore, the gases are released in three portions. These actions combine to reduce jump, and shock to the carriage to a minimum.

The muzzle brake has an approximate life of 5,000 E.F.C. rounds.

A clinometer plane is cut parallel to the bore at the muzzle end in order to avoid the necessity of allowing for droop when the sights are being tested. A number of Mark I barrels that are not provided with a clinometer plane have been issued to the service.

The Mark I barrel is autofrettaged, the Mark II is not.

The **jacket** is bored to receive the barrel and extends from a shoulder inside the breech ring to within 41·403 inches of the muzzle face of the barrel. The front end of the jacket is screw-threaded to receive a bronze sealing collar, whilst the rear is prepared with interrupted buttress screw threads for the attachment of the breech ring. The collar is provided for the purpose of excluding moisture from the junction of the barrel and jacket.

Thrust collars are formed near the rear end to connect the gun to the recoil cylinder.

A counterweight, of mechanite or cast iron, is fitted to the rear end of the jacket and secured by six screws, each with a spring washer. It is rectangular in shape, the inside being shaped to suit the contour of the upper half of the jacket.

The **breech ring** is prepared internally at the front with interrupted screw threads to engage the threads on the jacket, and arranged so that the ring becomes fully engaged when rotated through one-eighth of a revolution. The breech ring is retained in position by a securing screw, and a stop screw, secured by a check screw, is provided to limit rotary movement on dismantling or assembly. In addition, a stop stud for the breech mechanism lever catch, secured by a check screw, is fitted to the breech ring.

A plane to accommodate the clinometer is prepared on the left side of the breech ring, which is also prepared for the reception of the breech mechanism.

The words ENGAGE, DISMANTLE and LOCKED, together with indicating arrows and fine axis lines are engraved on the upper face of the jacket, the engraving being filled in with red wax. In addition, the nature and Mark of the gun, the jacket number, year of manufacture, contractor's initials and the actual weight of the gun (without breech mechanism) are stamped on the same face together with a line with the letters C. of G. to indicate the centre of gravity of the gun (without breech mechanism and unloaded). In front of the C. of G. is the Royal Monogram.

The nature and Mark of the gun, contractor's initials, year of manufacture and an axis line are marked on the top of the breech ring, also an axis line and the breech ring number on the right side. Horizontal and vertical fine axis lines are cut on the rear face of the breech ring and in addition, an indicating arrow with a fine axis line, filled in with red wax, is cut on the upper front surface of the breech ring to assist assembly. In future, the cutting of axis lines on the breech face will be discontinued.

The word TOP, actual weight of the barrel, nature and Mark of gun and a line with letters C. of G. are etched on the upper surface of the barrel. The registered number of the barrel, manufacturer's initials, Mark of rifling and date of manufacture (month and year) are stamped on the muzzle face, together with fine axis lines which are cut across the muzzle face.

The Mark III gun is generally similar to the *Mark II*, differing principally in the shape of the shot seating.

BALLISTIC DATA

Charge, nominal weight—	
Cordite, M.D.8 and 2¼	1 lb. 10 oz. 13 dr.
Cordite, R.D.B.8 and 2¼	1 lb. 10 oz. 13 dr.
Cordite, W.057 and W.016	1 lb. 11 oz. 4 dr.
Cordite, W.T.206–100	2 lb. 8 oz. 8 dr.
Projectile weight with No. 117 or 119 fuze (approx.)	25 lb.
M.V. of a new gun at 60 degs. Fahr. f.s.—	
W.057 charge	1,486 f.s.
W.T.206–100 charge	1,747 f.s.
Shot travel with driving band design DD(L)6487/2	77·905 inches.
Working pressure (tons per square inch)	15·5.
Maximum range with super charge (R.T.M.V. of 1,700 f.s.)	13,400 yards.
Area of bore	9·348 square inches.

INSERTION AND REMOVAL OF LOOSE BARRELS

Tools required

Tool, artillery—	
No. 85	For the insertion of the barrel and fits into the chamber end of the barrel.
No. 86	For the removal of the barrel and fits into the muzzle end of the barrel.
Wrench, sealing, collar	For the removal and replacement of the sealing collar.

To remove the barrel

(*a*) Lay the gun at approximately zero degrees elevation and lash the hand wheel.

(*b*) Lock the wheels and put the brakes hard on by the hand lever and scotch the wheels.

(*c*) Dismantle the breech mechanism.

(*d*) Slacken the breech ring securing screw until it is clear of the jacket.

(*e*) Rotate the breech ring in an anti-clockwise direction until the arrow on the breech ring is opposite the arrow on the jacket marked DISMANTLE. A tap, on a handspike through the breech mortise, may be necessary to start the unscrewing.

(*f*) The breech ring can now be removed by sliding its threaded portion through the interruptions in the jacket.

(*g*) Remove the sealing collar with the sealing collar wrench provided.

(*h*) Insert the No. 86 tool in the muzzle and, with a suitable piece of skidding, tap the tool until the barrel is loosened. At the same time a handspike should be entered into the chamber to assist in the removal.

(*i*) Remove the No. 86 tool. The barrel can now be drawn to the rear until the C. of G. is clear.

(*j*) Place a sling around the C. of G. and pass a handspike through the loops. Two men, one at each end of the handspike, can now remove the barrel completely, a third steadying the barrel with the handspike in the breech end to prevent it fouling the jacket.

To insert the loose barrel

(*a*) See that the word TOP, engraved near the breech end, is uppermost.

(*b*) Place a handspike in the chamber, manned by one man, and a sling round the C. of G. of the barrel. Pass a handspike through the loops of the sling and with a man at each end of the handspike insert the barrel into the jacket as far as the C. of G. of the barrel. Care should be taken by the man at the handspike in the chamber to guide the barrel through the jacket without fouling it.

(*c*) Remove the handspike and sling and push the barrel gently into the jacket, care being taken to see that the grooves in the shoulder of the barrel are correctly aligned to receive the loose barrel securing screws.

(*d*) Insert the No. 85 tool in the chamber and, with a suitable piece of skidding, tap the barrel gently home.

(*e*) Remove the No. 85 tool and replace the sealing collar, care being taken to ascertain that the joints of the packing rings are diametrically opposite.

(*f*) Slide the breech ring on to the jacket, keeping the arrow on the breech ring in line with the arrow on the jacket marked ENGAGE. Rotate the breech ring in a clockwise direction until the arrow on the ring coincides with the arrow on the jacket marked LOCKED.

(*g*) Tighten up the breech ring securing screw.

(*h*) Assemble the breech mechanism.

Care and preservation.

Barrels screw-threaded to take muzzle brakes will *not* be fired without the muzzle brake, unless such a course is operationally essential. Firing without the muzzle brake might result in ovality developing at the muzzle.

After firing, a deposit forms between the muzzle brake and the barrel. If this is not removed seizure is likely to occur. To prevent this, the brakes will be removed occasionally and the threads of the barrel and muzzle brake will be thoroughly cleaned and given a very light coating of graphite grease. *No other lubricant is permissible.*

BREECH MECHANISM

(PLATES 1 AND 2)

The breech mechanism of the Mark II gun is of the vertical sliding block type, opened and closed by hand and actuated by a breech mechanism lever through the actuating shaft and crank. The crank, which is fitted with two rollers, slides in a groove formed in the recess of the breech block. The block is retained in the open position by means of the extractor levers, the hooks of which engage shoulders formed towards the upper end of the front face of the breech block, when the block is lowered, being held against the shoulders by the action of the buffer on the toe of the breech mechanism lever. The extractors are released by the insertion of a cartridge, allowing the action of the buffer spring to partially close the block, thus preventing the cartridge from slipping backwards when the gun is at a high angle of elevation. Obturation is obtained by the cartridge case expanding radially against the walls of the chamber on firing. The method of firing is by percussion, operated by a lever attached to the carriage.

The principal parts of the breech and firing mechanism are as follows :—

Block, breech A or B—steel ; body with bottom plate with six screwed rivets, firing-hole bush, fixing screw and intermediate cocking lever bracket with four fixing screws.

Lever, breech mechanism A or B—steel ; body, catch with collar, split keep pin, plunger with retaining screw and spring, and actuating lever.

Shaft, actuating—steel ; shaft with nut and split keep pin.

Sleeve, actuating shaft—steel.

Crank, actuating, breech block—steel ; body with two rollers, two roller retaining collars and two keep pins.

Lever, cocking, intermediate—steel ; lever with axis pin with split keep pin and roller with axis stud.

Buffer, breech block A or B—bronze ; bracket with locking screw, plunger with nut and keep pin, and spring.

Lever, extractor, left—steel.

Lever, extractor, right—steel.

Case, striker, A or B—steel ; body with safety catch stop stud and four split keep pins ; retaining catch plunger with head with taper keep pin and spring ; trigger-sear ; trigger-sear spring ; trigger-sear spring seat ; two

rollers; two roller axis pins; safety catch with plunger with split keep pin, plunger spring and, with A assembly, retaining pin or, with B assembly, retaining screw; and striker consisting of cocking sleeve, main spring and spindle with firing pin and firing pin retaining staple, cocking handle with cross handle, rivet and keep pin; and cocking lever with axis pin and retaining screw.

Lever, control—steel; lever with plunger with retaining pin and spring.

Bracket, firing A or B—bronze; bracket with four fixing screws; lever with two rollers and roller axis pins; lever axis pin and bar. (There are no rollers or roller axis pins with the B assembly.)

Rod, firing—steel rod with bronze bracket with two fixing screws.

In order to facilitate manufacture, certain assemblies forming part of the breech mechanism, have been manufactured to a simplified design, and the suffix B has been added to the nomenclature of these assemblies to distinguish them from those manufactured to the original design which bear the suffix A.

All breech mechanisms will have certain parts and assemblies that bear no suffix and are common to all mechanisms of the Mark II 25-pr., however constructed. The remainder of the mechanism may consist of all A assemblies, all B assemblies, or any combination of A and B assemblies as indicated hereafter.

Details which bear no suffix and are common to all mechanisms.

Crank, actuating, breech block.
Lever, cocking, intermediate.
Lever, control.
Lever, extractor, left.
Lever, extractor, right.
Rod, firing.
Shaft, actuating.
Sleeve, actuating shaft.

Assemblies which may be of A design or of B design.

(*The A design being interchangeable with the B design and vice versa.*)

Block, breech.
Bracket, firing.
Buffer, breech block.
Case, striker.
Lever, breech mechanism.

Any complete mechanism is interchangeable as a whole with any other complete mechanism, irrespective of the design of the parts of which it is comprised. Similarly, any complete A assembly is interchangeable with any complete B assembly of similar nature but it must be noted that certain details of the A assembly, particulars of which are given hereafter, are not interchangeable with similar details of the B assembly, e.g., an A striker case could be substituted for a B striker case, and *vice versa*, but the safety catch of an A striker case could not be replaced by the safety catch of a B striker case.

Parts that are not interchangeable between A and B assemblies.

Block, breech—
  Block
  Bracket, intermediate cocking lever
    Fixing screw.
Bracket, firing—
  Bar
  Bracket
  Lever
  Roller axis pin } used only with A assembly
  Roller

Buffer, breech block—
  Bracket
    Locking screw
  Plunger
    Nut
  Spring
Case, striker—
  Case and 3 keep pins
  Safety catch
    Retaining pin (A assembly)
    Retaining screw (B assembly)
  Roller axis pin
  Retaining catch plunger with head
Striker, percussion—
  Cocking sleeve
  Striker spindle
    Cocking handle
      Cross handle
    Spindle
Lever, breech mechanism—
  Lever
  Plunger catch

The **breech block** (Fig. 2) is rectangular in shape and slides in the vertical slot in the breech ring, having inclined guides on both sides to engage the guide grooves cut in the slot of the breech ring. The inclination of the guides and grooves causes the block to move forward slightly during the motion of closing and so presses the cartridge into the chamber. It is bored axially and prepared at the rear with two interrupted thrust collars to receive the striker case, the front end being threaded to accommodate a removable firing-hole bush which is secured in position by a fixing screw. The rear face is prepared with an inclined radial groove and recess to receive the front end of the striker case retaining catch plunger, also with a radial groove and clearance to suit the front end of the striker case safety catch lever. Cuttings are made towards the base of the block to give clearance for the intermediate cocking lever and the crank, paths being cut in the crank recess for the crank rollers when the breech is being operated. An inclined recess is cut in the left side of the rear face to receive the stop on the control lever.

The front face of the block, in front of the guides, is shaped to form a path whereby the toe of the extractor levers is actuated when the breech is opened, thus unseating and ejecting the cartridge case. In addition, towards the top of the block, shoulders are formed to engage the hooks on the extractor levers to retain the block in the open position. A hole is drilled from the crank recess to the front of the striker case recess to allow for the escape of gas. The rear face is recessed towards the bottom to receive the bronze intermediate cocking lever bracket, the recess having four tapped holes for the bracket fixing screws.

A plate, secured by six screws, is attached to a recess in the bottom of the block to prevent the ingress of dirt. The upper face is suitably shaped to facilitate the loading of the cartridge, the front edge being bevelled to assist the cartridge into the chamber.

The **B breech block** assembly is of a simplified design, and is generally similar to the A breech block assembly with which it is interchangeable. The following components of the B assembly differ from similar components of the A assembly to such an extent as to render them non-interchangeable—

Block.

Intermediate cocking lever bracket with fixing screw.

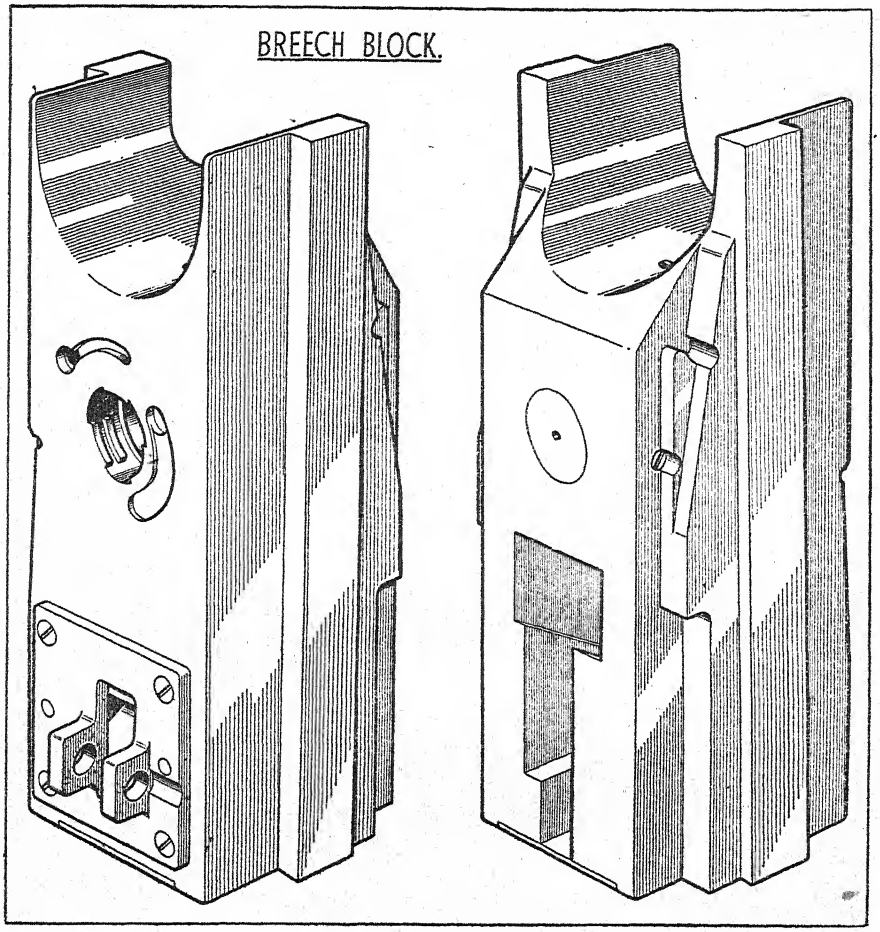

FIG. 2

The **A breech mechanism lever** (Fig. 3) is bored and keyed to assemble on the actuating shaft on the right side of the breech ring. It is fitted with a catch at the upper end, to engage a stop stud towards the top of the breech ring, the catch being released by pressing the actuating lever into a recess cut in the handle portion of the breech mechanism lever. The actuating lever is attached to the catch by means of a square, cut on the spindle portion of the catch, which engages a square hole in the actuating lever. The breech mechanism lever is bored to receive a catch plunger with its spring, the plunger being prevented from coming out of position by a retaining screw. The lever is also bored to receive the spindle portion of the catch, the catch being retained in position by a collar with a keep pin. A hardened lug is formed at the extreme bottom end of the lever to engage the buffer plunger which is fitted to the right-hand side of the breech ring. The catch face and the head of the plunger are also hardened.

The **B breech mechanism lever** is of simplified design. As a complete assembly it is interchangeable with the A breech mechanism lever. All its component parts, with the exception of the plunger and the lever body, are interchangeable with similar parts of the A breech mechanism lever.

The **actuating shaft** (Fig. 3) is supported in bronze bearings towards the base of the breech ring, being inserted from the left-hand side. A head is formed at the left-hand

end and it is threaded and drilled at the other to receive a nut and split keep pin. Three keyways are cut in the shaft to receive the breech mechanism lever, crank and actuating shaft sleeve, which functions in the right-hand bearing left of the breech mechanism lever. The extractor levers also pivot on the shaft which is lubricated by means of two Tecalemit lubricators in the base of the breech ring, the lubricant being conveyed to the shaft and sleeve by holes through the bearings and oil grooves cut in the inner side of the head of the shaft and on the outside of the sleeve.

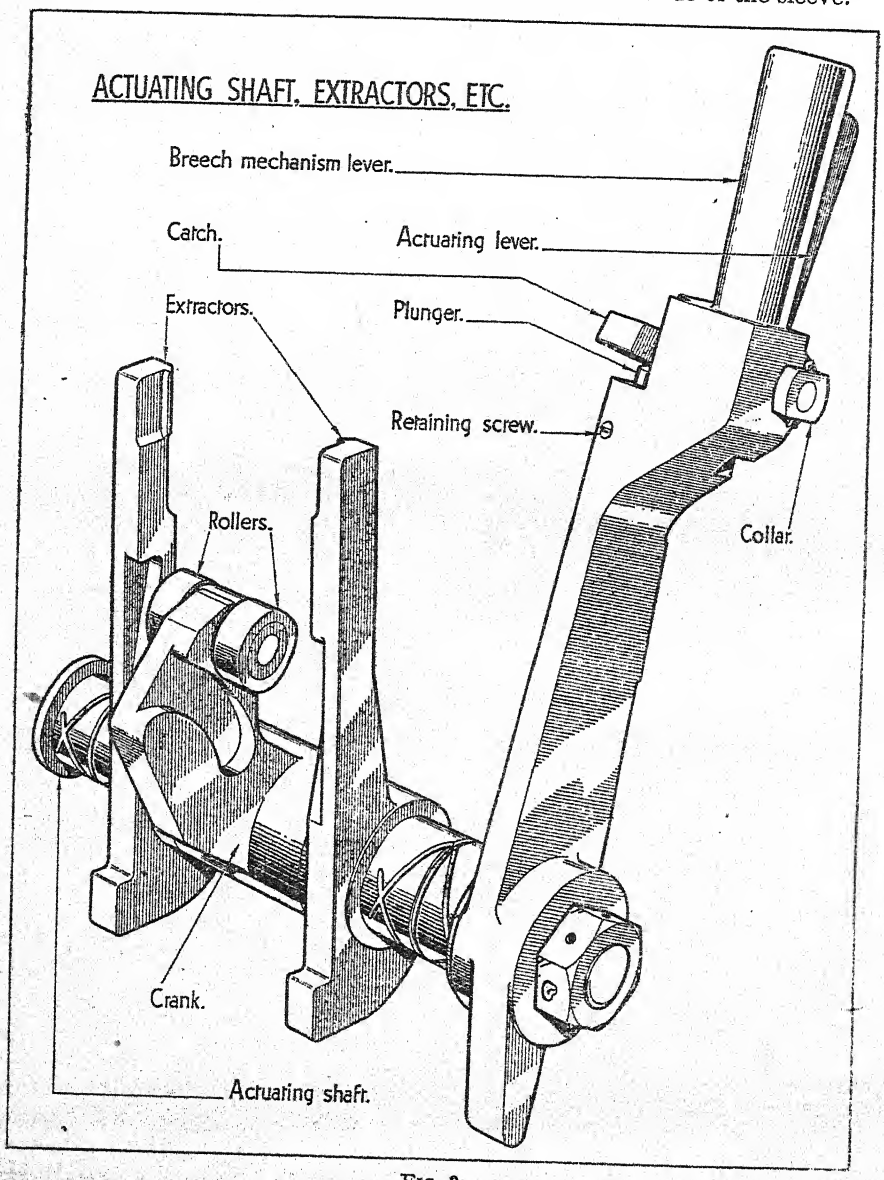

FIG. 3

The **breech block actuating crank** (Fig. 4) is bored and keyed to assemble on the actuating shaft and is provided with an arm with spigots on either side for the assembly of the rollers, which are secured in position by retaining collars. In addition, a recess is cut in the arm to act as a path for the intermediate cocking lever roller. Lines are engraved on the spigot ends and the retaining collars to facilitate assembly.

The **intermediate cocking lever** (Fig. 5) consists of two arms and a boss which is bored to receive the axis pin. The longer of the two arms has a tapped hole in its end to receive the roller axis stud, the end of the stud being lightly riveted over when the roller is in position ; the end of the shorter arm is hardened to engage the cocking lever. The lever is pivoted about its axis pin in the intermediate cocking lever bracket attached to the rear face of the breech block, the pin being secured by a split keep pin.

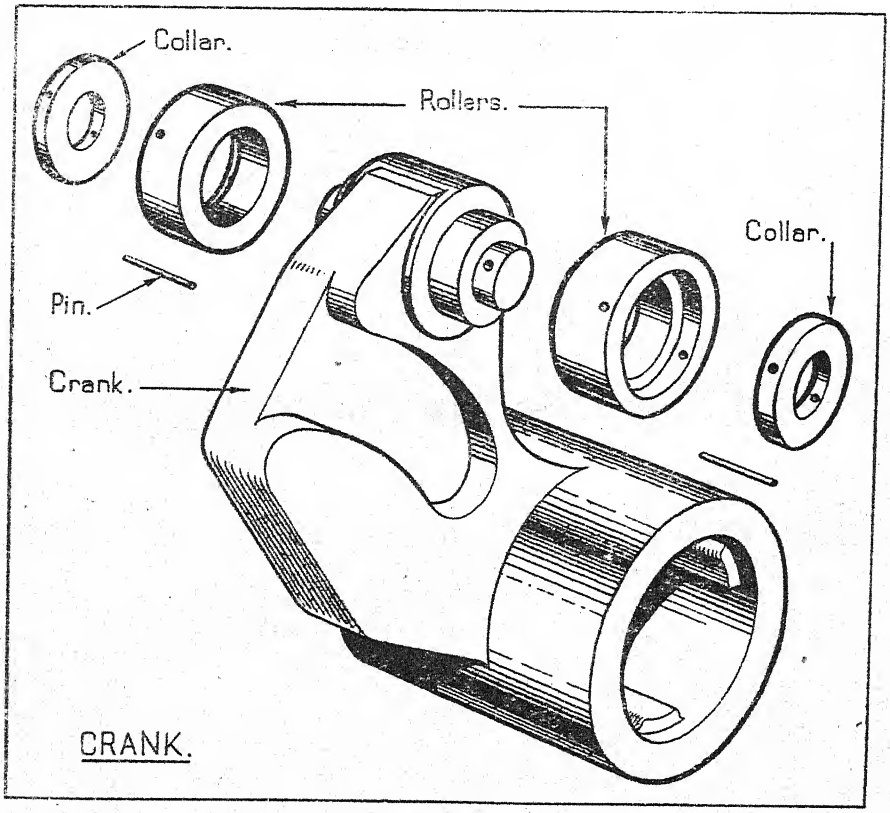

FIG. 4

The **cocking lever** (Fig. 5) consists of a boss with two arms, the boss being bored to receive an axis pin, which is secured by a retaining screw in the striker case. The arms are arranged to engage the intermediate cocking lever and the recess in the striker spindle respectively. The working faces at the ends of the arms are hardened.

The **A breech block buffer** (Fig. 6) is provided to retain the breech block against the hook of the extractor levers when the block is opened, to partially close the breech when the cartridge is in the chamber so acting as a cartridge retainer, also to free the extractors for loading. It consists of a bronze bracket with lugs which fit into a recess cut in the right side of the breech ring and is locked in position by a screw having a tapered head which fits into a corresponding taper machined in the lug of the bracket and stamped with the words SCREW OUT TO LOCK. The bracket is bored longitudinally to receive the plunger and spring, a keyway being cut at the bottom to receive a corresponding key on the head of the plunger. The top portion is bored to a smaller diameter to accommodate the plain portion of the plunger, beyond which is a threaded portion for the nut, a hole being drilled for a split keep pin. A spiral spring held in compression between the head of the plunger and the

shoulder inside the bracket completes the assembly. An air vent is drilled towards the top of the bracket.

The **B breech block buffer** is of simplified design but generally resembles those that are constructed to the A design with which it is interchangeable as a complete assembly. The only item common to the A and B designs is the split keep pin of the plunger nut.

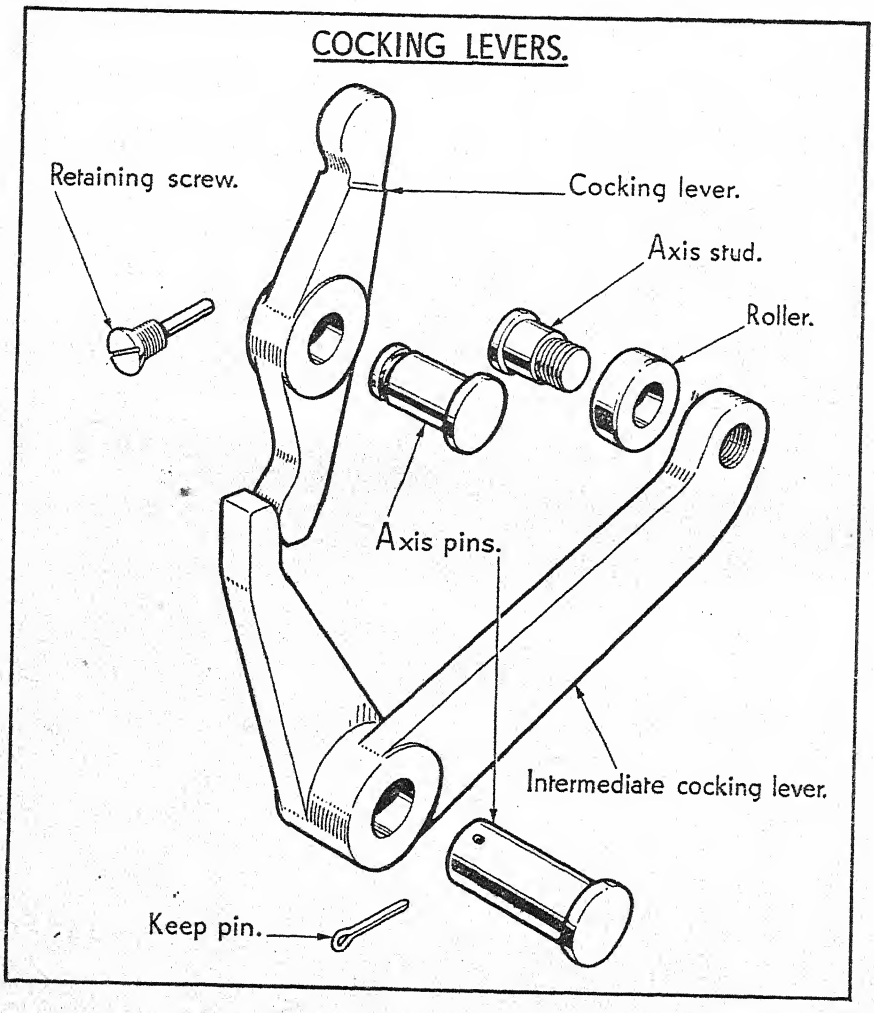

FIG. 5

The **extractor levers** (Fig. 3) left and right, are similar in design but differently handed; they are stamped LEFT and RIGHT respectively and bored to pivot on the actuating shaft on each side of the crank. The arm of the lever extends upwards and has a hook formed to engage a shoulder on the breech block when the breech is open, to retain the block in the loading position. Hardened toe pieces are formed at the bottom of the levers to engage with the breech block paths which operate the levers.

The **striker case** consists principally of a body, retaining catch, trigger-sear, safety catch, cocking lever and striker.

BREECH BLOCK BUFFER.

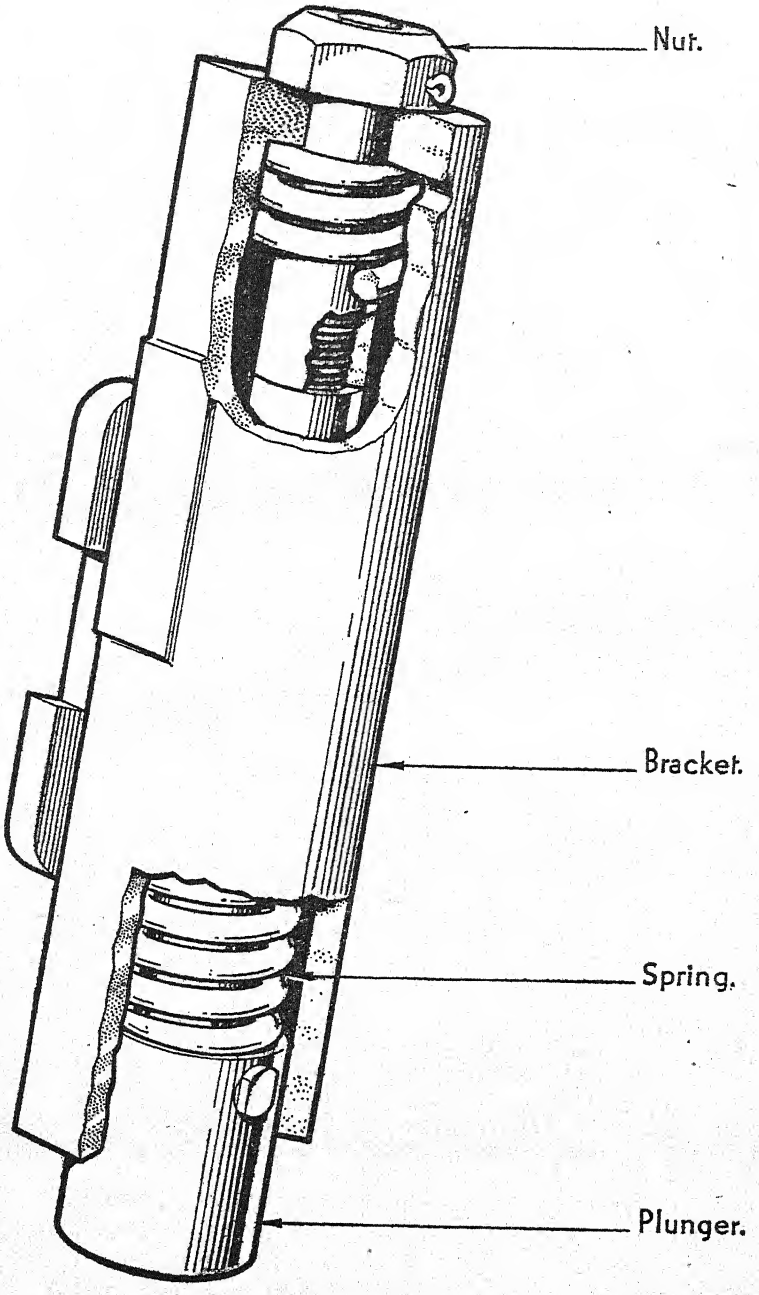

FIG. 6

The **body,** of steel, (Fig 7) is bored centrally in two diameters to receive the striker spindle, the shoulder formed by the reduction in diameter acting as a seating for the main spring. The exterior of the front portion is turned to two diameters, the larger nearest to the rear of the case being prepared with interrupted thrust collars to engage corresponding collars in the breech block. The rear portion is enlarged and a recess is prepared to accommodate the trigger-sear and a trigger-sear spring. Two holes are bored in bosses formed on the top face to receive the roller axis pins, the pins being retained in position by split keep pins. The third boss on the top face is drilled and slotted to receive the safety catch retaining pin which is secured by a split keep pin. A hole is drilled through a boss at the right end of the trigger-sear recess for a split pin which secures the trigger-sear spring seat. The words FIRE and SAFE are engraved on the rear face and filled in with red wax, to indicate the alternative positions of the safety catch, and two conical recesses are prepared for the plunger of the safety catch. A safety catch stop stud, prepared with a flat on the head, is screwed into the rear face. Two lugs on the under side are bored to receive the

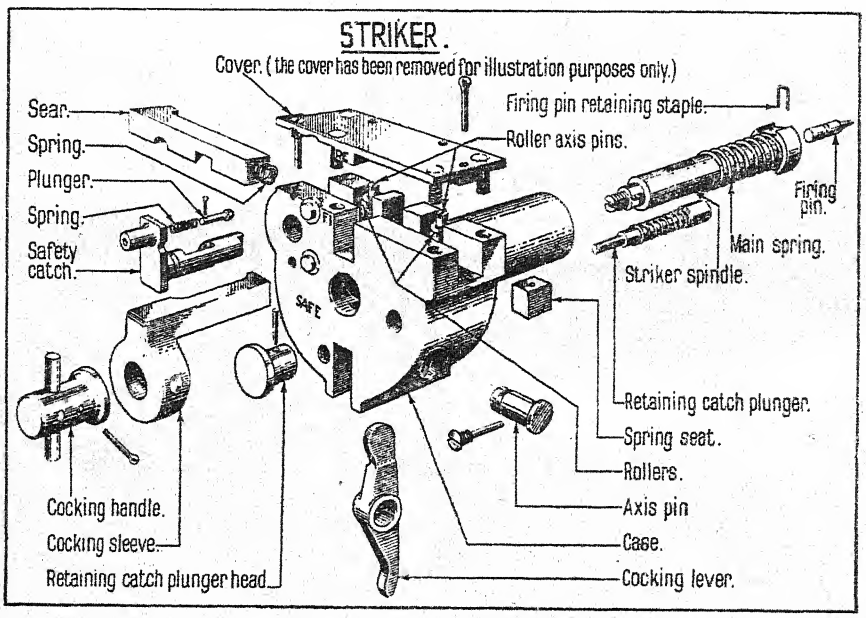

FIG. 7

axis pin for the cocking lever and a rectangular slot cut above the central boring to accommodate the arm of the cocking sleeve. In addition, the rear face is prepared to receive the retaining screw for the cocking lever. A hole is bored to the right of the rear face to accommodate the retaining catch plunger ; the hole has a featherway to prevent the plunger from rotating.

To facilitate manufacture, striker cases will, in future, have the recess for the head of the cocking lever axis pin omitted, and the head of the axis pin machined to the body diameter of the axis pin.

Should it be necessary, on replacement, to fit an axis pin of the existing type to a striker case of future manufacture the head of the axis pin will be reduced to the body diameter.

The **retaining catch** (Fig. 7) consists of a plunger with head, taper pin and spring. Its function is to engage a recess in the breech block and retain the striker case in the locked position. A head is secured to the plunger by means of flats and a keep pin. A lug projects from the head and is cross-hatched to provide a finger grip.

The **trigger-sear** (Fig. 7) is of rectangular section and slides in a recess cut in the striker case, smoothness of action being obtained by the use of two rollers which are in contact with the front face. It is bored at the right end to receive its spring and is slotted underneath to receive an arm of the cocking sleeve. A semicircular slot is cut on the under side to engage the safety catch when the latter is set at SAFE ; a toe is formed at the left end to receive the firing-bracket bar when the firing lever is operated. The trigger-sear spring seat is housed in the striker case, the spring actuating the sear and retaining it in engagement with the cocking sleeve.

The **safety catch** (Fig. 7) is carried in a recess in the striker case. It consists of a spindle with an arm at the outer end which is cross-hatched to provide a finger grip. A plunger with a spring is housed in the arm, the plunger being provided with a conical head to engage the recesses in the striker case and so retain the safety catch in the SAFE or FIRE position against accidental movement.

A split pin is provided to retain the plunger in position against the spring. A retaining pin, which engages a semicircular groove in the spindle portion of the safety catch and is secured in the striker case, prevents any rearward movement of the catch. A clearance is cut in the spindle to permit the trigger-sear to function when the safety catch is set at FIRE, the rounded portion of the spindle adjoining the clearance being arranged to engage the recess in the trigger-sear and restrict the movement of the latter when set at SAFE. The front end of the spindle is prepared with a semicircular projection which, by engaging in a groove in the rear face of the breech block, necessitates the striker case being assembled to, or dismantled from, the block with the striker cocked and the safety catch set in a SAFE position.

The **percussion striker,** of steel, which forms part of the striker case consists principally of a striker spindle, cocking handle, cocking sleeve and main spring.

The **A striker spindle** (Fig. 7) is recessed at the front for the firing pin, which is secured in position by a retaining staple. It is threaded and drilled at the rear for the cocking handle, with keep pin. In front of the cocking handle, flats are prepared to receive the cocking sleeve. The head of the spindle forms the front seating for the main spring. A recess is cut in the head to allow for the escape of gas, also, a slot is cut in the plain portion to receive the cocking lever. A transverse hole is drilled for the insertion of a No. 18 drift to facilitate removal of the firing pin.

The **B striker spindle** differs from the A in that it has a keyway at the rear end instead of flats, the cocking sleeve having a plain hole for the reception of the spindle. A tapped hole is prepared in the side of the sleeve to allow a screw to be fitted which protrudes and acts as a key, the screw being riveted over after it is screwed in position.

The spindle and sleeve are designed to obviate jamming between the cocking lever and the striker spindle, when the striker is cocked by hand.

The **cocking handle** (Fig. 7) screws on to the end of the striker spindle, hard against the cocking sleeve, and is secured by a keep pin. It is provided with a cross handle for recocking by hand in the event of a misfire.

The **cocking sleeve** (Fig. 7) fits on the striker spindle, immediately in front of the cocking handle. It has an arm which enters a slot cut in the rear portion of the striker case and engages the recess cut in the trigger-sear. The front of the arm is hardened and polished and a step is cut in the end to engage a similar step in the trigger-sear recess, the sear spring holding the sear against the arm thereby retaining the striker in the cocked position.

The **main spring** (Fig. 7) is tempered, nickel plated wire, round in section.

The **control lever** (Fig. 8) is a steel fitment consisting of an arm with a spring plunger at the top, hinged on a stud situated on the left rear face of the breech ring and retained in position by a washer, slotted nut and keep pin. The plunger operates against a stop stud towards the top of the left rear face of the breech ring, its function being to maintain the control lever in contact with the firing-bracket bar, and to return the bar to its normal position after the gun has been fired. At the centre of

the arm portion a stop is formed which operates in a recess cut in the breech ring. Until the breech is fully closed the stop will foul the edge of the breech block when the bar is operated, thus preventing the release of the striker. In addition, towards the bottom of the arm, a cutting is made to give clearance to the cocking lever when the striker case is being removed from the breech block.

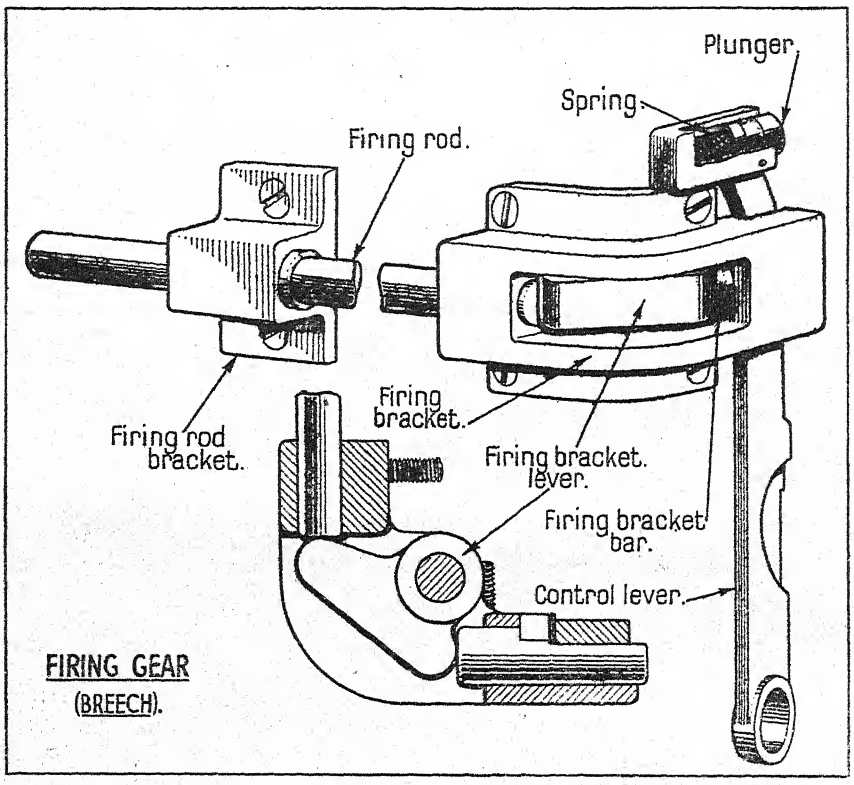

FIG. 8

The **B striker case** is of simplified design and, as a complete assembly, is interchangeable with the A striker case. The body of the case, the safety catch with retaining pin, the roller axis pin, the retaining catch plunger with head and the percussion striker are not interchangeable between A and B assemblies although the main spring and the firing pin with its staple are common to both designs of percussion strikers.

The **A firing bracket,** of bronze, consists principally of a bracket, lever with two rollers and a bar.

The **bracket** (Fig. 8) is situated on the left side of the breech ring, adjacent to the trigger-sear. It is a right-angled bronze casting cored in the centre to clear the lever and its rollers, the ends being machined to support the firing rod and the bar respectively. The flange portion has four countersunk holes to accommodate the fixing screws and a hole is bored to receive the lever axis pin. The end to accommodate the bar is keyed and recessed to suit the shape of the bar.

The **firing bracket lever** (Fig. 8) of steel, consists of a boss, bored to receive the axis pin, and an arm machined at each end to clear the two rollers. The ends are drilled to receive the roller axis pins.

The **firing bracket bar** (Fig. 8) which operates the trigger-sear is generally circular in section with two keys formed on the sides and a projecting stop to engage the

control arm, in front of which a flat is cut. The keys operate in keyways cut in the firing bracket, the left-hand end of the bar engaging one of the firing bracket lever rollers and the other the trigger-sear.

The **B firing bracket** operates in a similar manner to the A, with which it is interchangeable as an assembly. The firing bracket lever of the B assembly has no rollers and the only parts interchangeable between the A and B assemblies are the fixing screws and the axis pin of the lever.

The firing rod (Fig. 8) of steel, has a collar formed at one end. The firing rod bracket which supports the front of the rod is secured to the left side of the breech ring by two fixing screws. The other end of the rod is supported by the firing bracket and engages the firing bracket lever roller, the collar of the rod resting against the side of the firing-rod bracket which acts as a stop and retains the rod in position.

The striker case is assembled as shown in (Fig. 7).

Action of the mechanism

(*a*) *To close the breech*

The action of inserting the cartridge into the chamber causes its rim to foul the extractor levers, releasing their hook from the shoulder on the breech block. When the hooks are free the breech block raises slightly, due to the action of the buffer plunger and spring acting upon the toe of the breech mechanism lever, thereby preventing the cartridge from slipping back at all angles of elevation.

The closing movement is continued by rotating the breech mechanism lever in a clockwise direction. The actuating shaft and crank rotate with the breech mechanism lever, the rollers of the crank, rolling along their path in the block, cause the latter to move in a vertical direction to the closed position. As the block moves it travels forward slightly due to its inclined grooves, thereby forcing the cartridge into the chamber.

The breech mechanism lever is retained in the closed position by the breech mechanism lever catch, before firing, and during firing by its own inertia tending to throw the lever further in a clockwise direction. The breech block is retained in the closed position and prevented from accidental opening, before firing, by the last movement of the crank rollers being past their dead centre position in relation to the angle of the path in which they travel. During firing, the inertia of the breech mechanism lever, as previously stated, retains the crank rollers beyond their dead centre, retaining the block in the closed position.

As the block reaches the closed position the trigger-sear of the striker case arrives in line with the firing-bracket bar, thus permitting the firing rod to be operated, also the recess in the left side of the rear face of the block is now in line with the stop on the control lever.

(*b*) *To fire*

The firing rod is operated by the firing gear on the carriage, the rod being pressed to the rear, its rear end coming into contact with the roller at one end of the firing-bracket lever, which rotates on its axis pin, causing the roller at the other end of the lever to press the firing-bracket bar on to the trigger-sear. Providing the breech block is fully closed, the trigger-sear is forced against its spring to release the arm of the cocking sleeve, thus allowing the striker spindle to move forward under the pressure of the main spring, the firing pin striking the percussion cap, so firing the charge. In the event of the breech block not being fully closed the stop on the control lever will foul the block, preventing the firing-bracket bar from actuating the trigger-sear.

After firing, the plunger and spring at the top of the control lever reassert themselves and force the lever to the left taking with it the firing-bracket bar to its normal position.

Should the gun fail to fire, the striker is recocked by drawing the cocking handle with sleeve and striker spindle to the rear, by means of a No. 4 cocking lanyard, until the trigger-sear engages in front of the upper arm of the sleeve by the action of the trigger-sear spring.

(*c*) *To open the breech*

The gun having fired, the breech mechanism lever is released by depressing the actuating lever, thus releasing the retaining catch; the breech mechanism lever is then free to be rotated in an anti-clockwise direction. The lever being keyed to the actuating shaft causes the crank to revolve, thus forcing the crank rollers in a downwards direction along their path in the block, so lowering the block.

As the block is lowered the toes of the extractors ride along the grooves in the block until they reach the inclined portion, when a slow powerful leverage is set up which unseats the fired cartridge. The grooves in the block terminate in a projection or shoulder and when the toes reach the latter, the extractors are given a quick jerk which ejects the empty case, at the same time the toe of the breech mechanism lever meets the plunger of the breech block buffer so cushioning the shock.

At this position of the block the extractors are incapable of movement, therefore the breech mechanism lever is released, the buffer forcing against the toe of the lever forces the block up slightly so releasing the extractors which fall back, allowing their hooks to engage the shoulders on the block, as the latter rises, retaining the block in the open position.

During the above movement, the roller on the arm of the intermediate cocking lever is forced down the path cut in the crank, causing the toe of the lever to engage the cocking lever, which in turn forces the striker spindle and cocking sleeve to the rear until the arm of the cocking sleeve is clear of the stop formed in the recess of the trigger-sear. The trigger-sear spring now forces the trigger sear into position and the striker is retained in the cocked position.

SAFETY ARRANGEMENTS

The gun cannot be fired until the breech block is fully closed for the following reasons:—

(*a*) The firing-bracket bar cannot operate the trigger-sear as the recess in the block is not opposite the stop on the control lever.

(*b*) The firing-bracket bar is not in line with the trigger-sear.

(*c*) The firing pin is not in line with the cap.

TO ASSEMBLE THE BREECH MECHANISM

(*a*) Insert the actuating shaft into the left-hand bearing of the breech ring, assembling the left extractor lever, crank and right extractor lever on the shaft respectively, from inside the breech opening.

(*b*) Press the actuating shaft sleeve into position in the right-hand bearing i.e., the face of the sleeve flange flush with the face of the bearing.

(*c*) Insert the retaining catch spring and plunger and screw home the plunger retaining screw.

(*d*) Place the catch actuating lever in its recess in the handle of the breech mechanism lever and assemble the catch from the left side of the lever with the arm towards the rear.

(*e*) Place the collar on the end of the spindle portion of the catch and secure with its keep pin. Place the breech mechanism lever on the end of the actuating shaft, tighten up the nut and secure with its keep pin.

(*f*) Place the intermediate cocking lever, with its roller arm in the recess in the rear face of the breech block, drive home axis pin through the bracket and boss and secure with its keep pin.

(*g*) Pull the breech mechanism lever to the rear past the fully open position and place the extractor levers in the vertical position. Lift the block so that it will just enter the guides in the breech ring and insert the crank in its recess in the breech block. Continue to close the breech by rotating the breech mechanism lever in a clockwise direction. The roller of the intermediate cocking lever will drop into position in the crank as the breech block is closed.

(*h*) Place the plunger and spring into the bracket of the buffer, screw down the

plunger nut and secure by means of its keep pin. Screw the bracket locking screw into the breech ring until the head is flush with the face of the ring, insert the bracket in its recess and unscrew the locking screw until its head is firmly fixed in the tapered hole in the bracket lug.

(*i*) Insert the plunger and spring in position in the control lever with the flat towards the bottom and drive home the retaining pin. Place the lever over its axis stud with the stop portion in the recess in the breech ring and secure with its nut and keep pin.

(*j*) Insert the firing-bracket lever with its rollers into the bracket and drive home the axis pin. Slide the bar into position, place the bracket on to the breech ring and secure by its four securing screws. See that the control lever is in its correct position to the right of the projection on the bar.

(*k*) Insert the firing rod in the firing bracket with the shortest end from the collar towards the front. Slide the firing-rod bracket over the front end and secure to the left side of the breech ring with its two fixing screws.

(*l*) Insert the striker case retaining catch plunger and spring in the hole in the front face of the striker case and secure by its head and keep pin.

(*m*) Insert the trigger-sear rollers in their recesses in the front face of the striker case and drive home their axis pins, securing them with keep pins. Place the spring seat in the right-hand end of the trigger-sear recess and secure with a keep pin. Insert the trigger-sear.

(*n*) Insert the safety catch plunger and spring in the arm portion and secure by its keep pin. Place the catch in the hole bored in the rear face of the striker case, insert the retaining pin in its boss and secure with its keep pin. Rotate the safety catch to the SAFE position to hold the sear against any action of the spring.

(*o*) Place the firing pin in position in the head of the striker spindle and secure by inserting the retaining staple in the holes provided in the flats on the head, ensuring that the closed end of the staple is at the top, *i.e.* opposite the gas-escape recess in the head.

(*p*) Place the main spring in position over the spindle and insert in the front of the case. Holding the head of the spindle against the spring, insert the arm of the cocking sleeve in its recess to engage the slot in the trigger-sear, first turning the safety catch to the FIRE position and press the sleeve home to engage the flats on the striker spindle.

(*q*) Screw up the cocking handle and secure with its keep pin. Cock the striker and place the safety catch in the SAFE position.

(*r*) Insert the boss of the cocking lever between the lugs at the bottom of the striker case, allowing the thinner arm to engage the recess in the striker spindle. Drive home the axis pin and secure by inserting the retaining screw in the rear face of the striker case.

(*s*) Insert the striker case into the breech block (with the retaining catch on the right, opposite its groove in the breech block) and revolve in an anti-clockwise direction for one-sixth of a turn when the retaining catch plunger will engage the recess in the breech block and secure the case against rotation.

(*t*) Turn the safety catch to the FIRE position and release the striker by pressing the firing lever on the carriage.

TO DISMANTLE THE BREECH MECHANISM

(Figs. 9 and 10)

1. Place the breech block in the closed position. Grasp the cocking handle and pull the striker to the rear to cock.

2. Rotate the safety catch to the SAFE position.

3. Pull back the retaining catch plunger, revolve the striker case in a clockwise direction for one-sixth of a turn to clear the interrupted collars in the breech block, and withdraw the striker case with striker.

4. Unscrew the axis pin retaining screw of the cocking lever, in the rear face of the striker case, and withdraw the axis pin and cocking lever.

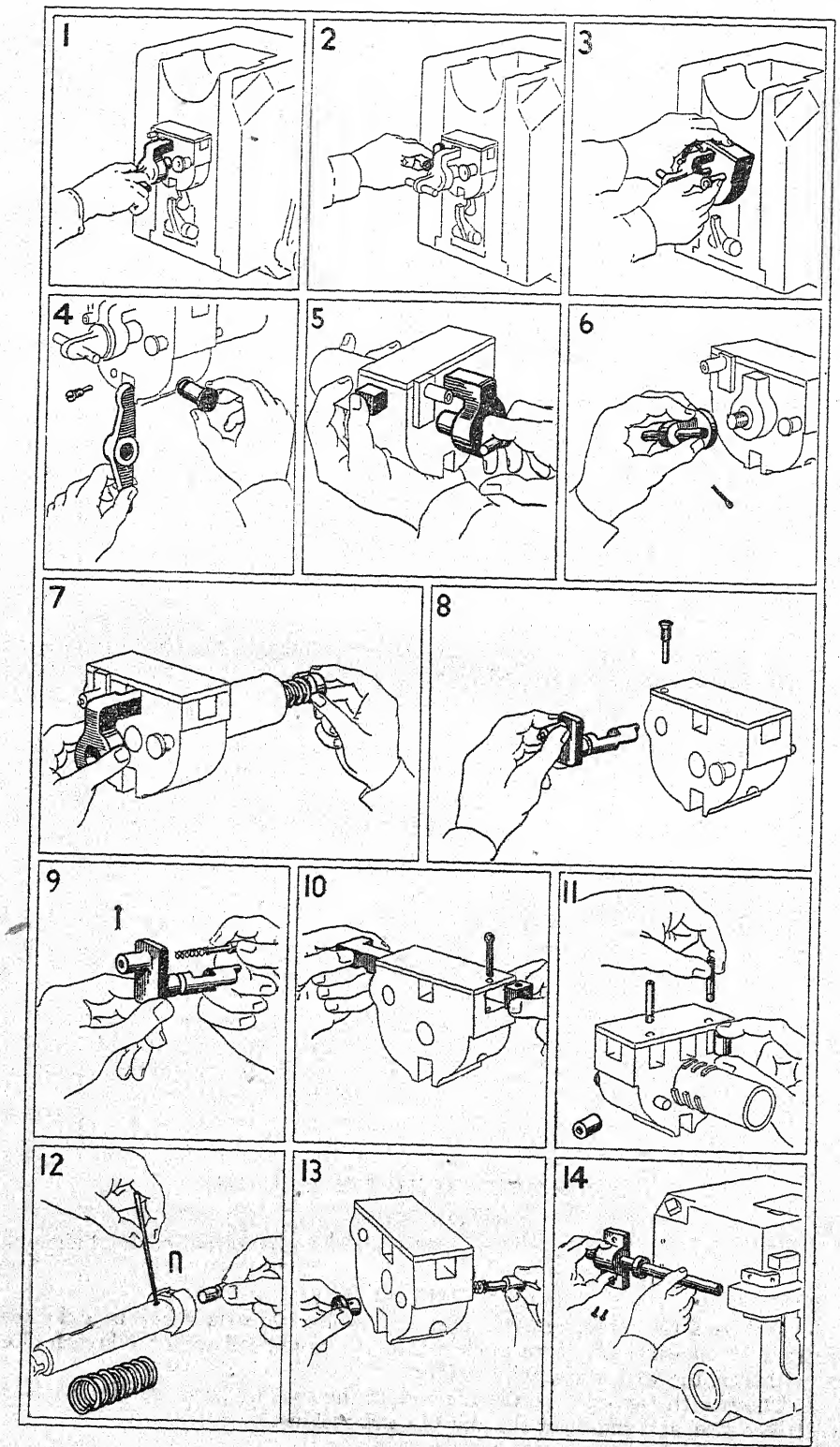

FIG. 9

5. Rotate the safety catch to the FIRE position. Grasp the cocking handle in one hand and the case in the other, and press the toe of the trigger sear to uncock.

6. Remove the keep pin from the cocking handle, and unscrew.

7. Withdraw the cocking sleeve from the rear and the spindle and main spring from the front of the case.

8. Remove the keep pin from the head of the retaining pin of the safety catch and withdraw the pin. Pull the catch to the rear to remove.

9. To dismantle the plunger, withdraw the keep pin from the spindle portion and remove the plunger and spring.

10. Remove the trigger sear and spring by withdrawing the toe end to the left, remove the keep pin securing the trigger-sear spring seat and withdraw the sear to the right.

11. Withdraw the keep pin from the head of the roller axis pins and insert a screwdriver in the slots in the bosses to give the pins their initial movement. The axis pins can now be withdrawn and the rollers taken from the recesses in which they are housed.

12. Remove the staple from the head of the striker spindle and, with the aid of the No. 18 drift inserted in the transverse hole behind the head, withdraw the firing pin.

13. Remove the keep pin and head of the striker case retaining catch plunger and withdraw the plunger and spring from the front of the case.

14. Remove the two firing bracket fixing screws from the breech ring and withdraw the firing rod.

15. Remove the firing bracket from the breech ring by releasing the four fixing screws.

16. Withdraw the bar from its recess, drive out the lever axis pin and remove the lever with its rollers from the bracket.

17. Withdraw the keep pin from the axis stud and release the nut of the control lever. Remove the lever from the stud.

18. Drive out the plunger retaining pin and withdraw the plunger and spring.

19. Rotate the locking screw of the buffer to the right to screw into the breech ring, until the head is below the surface of the ring.

20. Lift the buffer from its recess.

21. Remove the keep pin from the plunger nut, release the nut and withdraw the plunger spring.

22. Support the breech block with the left hand, release the breech mechanism lever retaining catch with the right hand and pull the lever towards the rear until the block is clear of the breech ring.

23. Remove the keep pin from the intermediate cocking lever axis pin and withdraw the axis pin. Remove the lever from its recess in the breech block.

24. Remove the keep pin from the actuating shaft nut, release the nut and withdraw the breech mechanism lever from the shaft.

25. Withdraw the keep pin from the retaining catch collar and remove the catch and actuating lever.

26. Release the plunger retaining screw and remove the plunger.

27. Drive the actuating shaft to the left, at the same time supporting the extractor levers and crank. Remove the extractor levers and crank.

28. Remove the sleeve from the right-hand bearing in the breech ring.

29. Dismantle the crank rollers by removing the retaining collar pins.

NOTE.—If the striker case is removed and the breech is opened, there is no resistance to the intermediate cocking lever, the usual resistance being the spring in the striker case. This may cause the roller of the intermediate cocking lever to become detached from the groove in the crank, if the breech block is lowered the maximum amount. The breech mechanism lever is then liable to become jammed in the fully open position.

To remedy this, pull gently on the intermediate cocking lever to return the roller to its correct path.

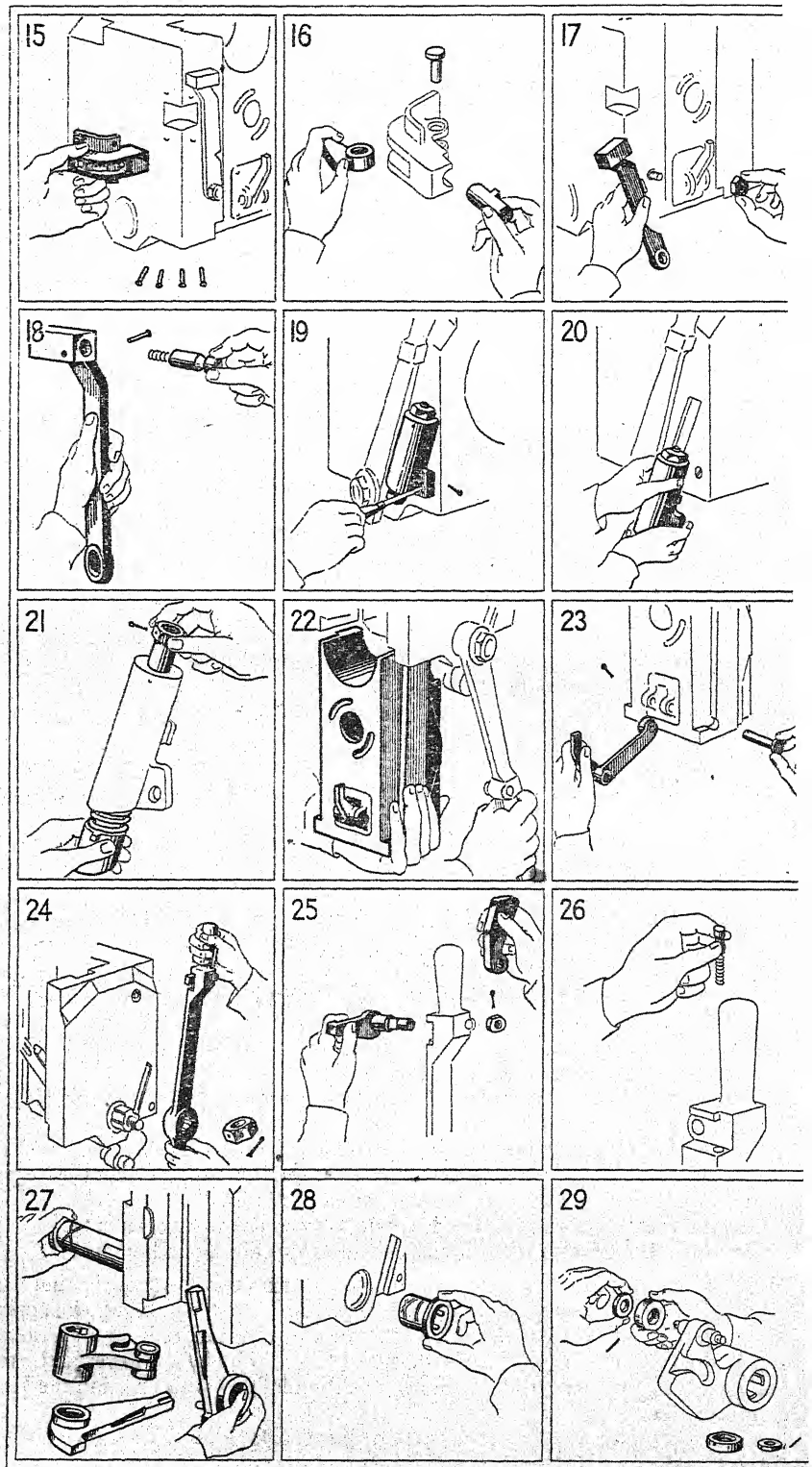

FIG. 10

TO GAUGE THE PROTRUSION OF THE STRIKER

(*a*) Remove the breech block from the gun.

(*b*) Replace the striker case with the striker completely assembled and press the trigger-sear inwards to release the striker.

(*c*) Apply the No. 16 protrusion gauge to the point of the firing pin, over the face of the breech block.

The minimum should foul and the maximum should clear the firing pin. If it does not do so the firing pin should be changed.

CARE AND PRESERVATION

Gun and fittings

Breech fittings should be frequently taken apart and inspected to ascertain that they are sound and in proper working order. They must be treated with care; violence and jerks should be avoided and no unnecessary force employed.

All spare parts must be tested for interchangeability as soon as possible after receipt.

Working surfaces and mechanisms must be well lubricated, should work easily and be free from burrs, which must be removed, where they exist, by an artificer.

Guns fitted with loose barrels will have the breech ring and barrel removed every three months. After removal, the bores, surfaces and threads will be cleaned, particular attention being paid to the removal of rust or grit in keyways, on keys and faces of shoulders. Before assembly the exterior of the barrel will be cleaned with an oily rag, C.70 oil being used, and it will be ascertained that the seating of the barrel is clean.

The clearance between the barrel and the jacket must on no account be filled with oil or grease.

The threads on both the breech end of the jacket and the inside of the breech ring, also the front end of the jacket and its sealing collar, will be coated with graphite grease. After reassembly, a coating of graphite grease will be applied to the front end of the breech ring to assist in excluding moisture.

If a flaw or crack is observed in a gun, the gun will be put out of action and arrangements made for it to be examined by the O.M.E. Should a similar defect be observed in any part of the mechanism the spare part allowed will be taken into use and the defective part forwarded to the O.M.E. for examination.

The whole of the exterior of the gun, except the clinometer plane, working surfaces at the breech end, screw threads and portions engaging the carriage, will be painted. The muzzle portion, so far as the muzzle cover extends, may be left unpainted.

Clinometer planes will not be cleaned with abrasive material such as emery cloth, scratch card or bath-brick. Any rust on the plane should be loosened with a coating of paraffin and then rubbed off with cotton waste. Care should be taken to prevent the plane being damaged or burred. The planes of guns in general use should be kept oiled. If a gun is not likely to be used for a considerable period the plane should be coated with mineral jelly.

The bore of the chamber should be inspected before and after firing, any defects being reported. Before firing, the bore will be thoroughly wiped out to ensure that it is quite clean and dry; it will be inspected by an officer.

When an accumulation of sand in the bore is a possible contingency, the following precautions will be observed.

(*a*) Whenever the tactical situation permits, guns will be left unloaded with muzzle and breech covers fitted in position.

(*b*) When it is necessary to keep guns loaded and ready for instant action, an improvised paper or light cotton fabric sand-proof-cover will be placed over the muzzle and secured by elastic or string. No danger of a premature or blind should arise if the gun is fired with this paper or light fabric cover in position.

(*c*) Firing through the service canvas muzzle cover may cause a blind with both the No. 117 and No. 119 fuzes and will not be permitted.

At the close of each day's firing the bore will be thoroughly washed out with hot water and the muzzle depressed. It should then be dried, and, when cool, well oiled, the oil being applied by means of a cloth or piece of old linen tied over the piasaba cleaner.

On completion of all practice, or when intervals of days occur between firing, the bore will be cleaned and oiled daily, until sweating has ceased.

Should the bore be very dirty, it may be cleaned with paraffin, after which, it will be wiped dry and oiled.

In extreme cases of fouling which have not been remedied by the previous methods, a hot (not boiling) solution of 1 lb. of caustic soda to one gallon of water may be used. The piasaba brush is covered with a piece of canvas, to make it a tight fit in the bore, dipped in the soda solution, and the bore rubbed until the fouling is loosened. The fouling can then be entirely removed with a hard brush. The bore and piasaba brush, including the wooden stave, will be thoroughly rinsed after the use of soda solution.

Immediately after firing, any deposit on the breech block and other parts should be removed, the parts thoroughly cleaned and oiled.

Grease must not be used for the lubrication of firing mechanisms as it will considerably diminish the force of blow of the striker and probably result in misfires. This is particularly liable to happen when the temperature is low.

Oil C.70 is the correct lubricant and only a very thin film should be applied. No. 1 low-cold-test oil is specially issued to those stations where extremely low temperatures are prevalent during the winter, but this oil should rarely be required in the United Kingdom.

When guns have to be kept ready for immediate action the firing mechanism should be stripped and cleaned daily. At other times it should be done at frequent intervals.

In order to prevent damage, and reduce wear to a minimum, the striker case will be removed whenever it is intended to use the service breech mechanism for drill and training. After drill, the mechanism must be stripped, thoroughly cleaned and then lubricated.

The striker main spring must on no account be weakened by annealing or shortening.

Guns, when not in use, should have their covers in position.

Soda in any form must on no account be used for cleaning the bore.

CHAPTER II

CARRIAGE, 25-PR., MARK I

(Plate 3)

The Mark I carriage is designed for use with mechanized draught and is constructed to give 40 degrees elevation and 5 degrees depression to the gun, coupled with a traverse of 4 degrees right or left of a centre line without disturbing the trail.

The gun must not be fired at a quadrant elevation exceeding 20 degrees when the upper flap of the shield is lowered. The traverse is effected by causing the saddle, with cradle and gun, to move over the top surface of the trail side brackets, whilst the front of the saddle pivots in its brackets on the trail.

The saddle is the traversing portion of the carriage and forms an intermediary between the trail and cradle.

The cradle carries the gun and recoil arrangements, the whole pivoting vertically in the saddle by means of the trunnions.

The recoil system comprises a hydraulic buffer, with hydro-pneumatic recuperator, a cut-off gear which shortens the recoil as the elevation increases, whilst a boring inside the cylinder block acts as a reservoir. The block is formed and shaped to carry the gun to which it is secured by means of a strap at the centre and a projection at the rear.

A crossbar, which is part of the trail, is provided, at each end of which are welded plates or stub axle supporting brackets and sleeves for the reception of the wheel assemblies.

Pneumatic wheels, comprising detachable wheels and anti-friction wheel hubs, are secured by means of their stub axles to the plates or stub axle supporting brackets of the crossbar.

Stays are fitted to the trail side brackets to support a steel bullet-proof shield for the protection of the detachment and carriage.

The brake operating gear is operated by means of a hand lever on the right side of the carriage. The lever is welded to a cross-shaft which transmits motion through linkage to the brake components of the wheel hub assemblies.

The sighting arrangements are on the reciprocating principle, consisting of a No. 18 carrier with a No. 7 to 7C dial sight carried on the left side of the saddle. The sight incorporates means of correcting for drift due to variations in charge, etc.

Rear lighting is provided in the form of a No. 5 identification lamp attached to the muzzle end of the piece when travelling. It projects a white light downwards which cannot be seen from above. Current for the lamp is supplied from a plug connected to the spare or rear light socket on the towing vehicle.

The principal parts of the carriage are as follows :—

- Trail—
  - Crossbar
- Wheels—
  - No. 14 pneumatic wheel (left)
  - No. 19 pneumatic wheel (right)
- Brake operating gear
- Cradle clamp
- Shield
- Saddle
- Traversing gear
- Elevating gear
- Firing gear
- Cradle
- Recoil system—
  - Buffer
  - Reservoir or tank
  - Recoil indicator
  - Cut-off gear
  - Recuperator
- Sighting.

TRAIL

The *Mark I* No. 1 trail (Fig. 11) is a built up steel box-shaped structure, inclining downwards towards the rear thus forming a hump.

It consists mainly of two hollow side brackets with top and bottom channels formed rectangular by the addition of inner and outer side plates riveted to them and strengthened at the hump portion by the addition of strengthening plates. The inner plates are formed with hand holes, closed by cover plates, to allow access to the rivets, whilst the front ends are closed by front closing plates. Facing plates for a pivot bracket and shield stays are secured to the front end.

The side brackets are joined together at the front by a box-shaped structure consisting of front, top and bottom transom plates, in addition, a saddle pivot bracket is riveted across the extreme front end.

The saddle pivot bracket consists of top, bottom and end plates. The top and bottom plates are bent to form a box and are welded together at the edges ; over this, at the front, is welded a towing shackle bracket which carries a towing shackle used for general purposes, the shackle being secured by a hinge pin. A hole is cut in the top and bottom plates to receive an upper and lower phosphor bronze bush for the reception of the saddle pivot, the bushes being secured by screws.

The rear end of the side brackets incline towards the trail eye and are joined together by a box-shaped structure consisting of a top and bottom plate, centre and rear transom plates, upper and lower transom angles and right and left rear stiffening plates.

Three hand holes are cut in the top plate, being supplied with covers with a lifting handle in the form of a staple ; these holes allow access to the interior. The extreme rear end of the trail is closed by a spade closing plate.

Bearing strips of phosphor bronze are riveted to the upper surface of the front end of the side brackets to minimize friction between the trail and saddle and to facilitate replacement.

Towards the front end of the outer side plates is riveted the left and right crossbar carrying brackets which are L-shaped, their under surface having two studs which are screw-threaded for the reception of slotted nuts and keep pins to secure the brackets on the crossbar.

The crossbar of steel, is circular in section, having two brackets, one at each end, welded to it for attachment to the studs on the trail. Plates or stub axle supporting brackets and sleeves are welded at each end for the reception of the wheel assemblies. The plates are drilled with eight equally spaced holes to receive the bolts of the stub axles and one for the cam lever of the brake shoes. The sleeves are bored to receive a spigot or dowel pin which is welded in position and enters the recess provided in the cross-shaft carrying brackets.

Keys and keyways are provided on the bar to position the sleeves and brackets before welding and to provide additional strength in the event of the welding breaking down.

Left and right brackets are fitted for the cradle clamp. The left one is hinged, the pin being secured by a keep pin. A Tecalemit lubricator is provided for the hinge pin. To the rear of the left cradle clamp bracket is a housing for the clamp when not in use.

Cradle clamp housing brackets will be strengthened by distance tubes placed between the inner and outer right side plates of the trail and secured by bolts instead of rivets.

Guides for the saddle clips, with phosphor bronze or high strength bronze liners, are riveted to the top of the brackets. The guides permit of necessary movement in traversing.

A pivot bracket for the traversing gear, which is a steel casting, is secured to the side of the left side bracket ; it is fitted with a phosphor bronze bush.

A supporting bracket for a seat is fitted to the left side for use of the gunners ; the seat can be adjusted and clamped in the required position by means of a handle. A saddle is riveted to the left top, towards the hump of the trail, for the air pump.

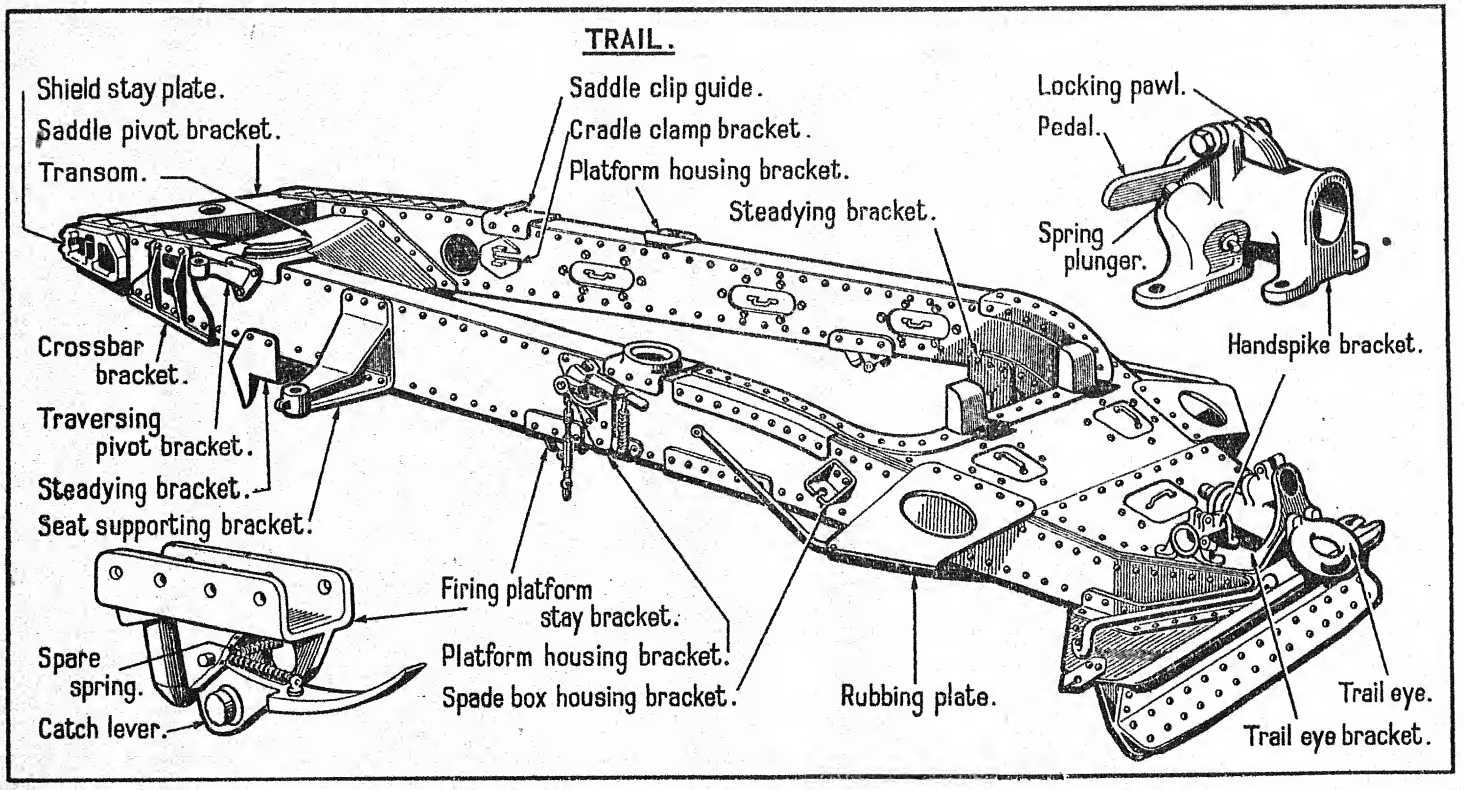
TRAIL.
Shield stay plate.
Saddle pivot bracket.
Transom.
Saddle clip guide.
Cradle clamp bracket.
Platform housing bracket.
Steadying bracket.
Locking pawl.
Pedal.
Spring plunger.
Handspike bracket.
Crossbar bracket.
Traversing pivot bracket.
Steadying bracket.
Seat supporting bracket.
Firing platform stay bracket.
Platform housing bracket.
Spade box housing bracket.
Rubbing plate.
Spare spring.
Catch lever.
Trail eye.
Trail eye bracket.

FIG. 11

Rubbing plates, of duralumin, are positioned on each side bracket at the rear, in line with the two front hand holes ; the plates make contact with the trailer wheels at extreme lock.

A guard bar is riveted to the front end of the rubbing plate and the trail to prevent injury to personnel.

Brackets are riveted to the under side of each trail bracket, about their centre, to accommodate the firing platform stays. A spring catch lever, with a phosphor bronze bush which is secured by a grub screw, pivoting on an axis pin, retains the stays in the required position. A spare spring is attached to a hook on the lever for immediate use in case of necessity. Tecalemit lubricators are fitted to each axis pin.

Should the catch be put out of action from failure of both springs or other damage, the stay connection of the platform may be retained on the spigot by the insertion of any suitable piece of wire, nail, etc., in the hole provided in the lower end of the spigot.

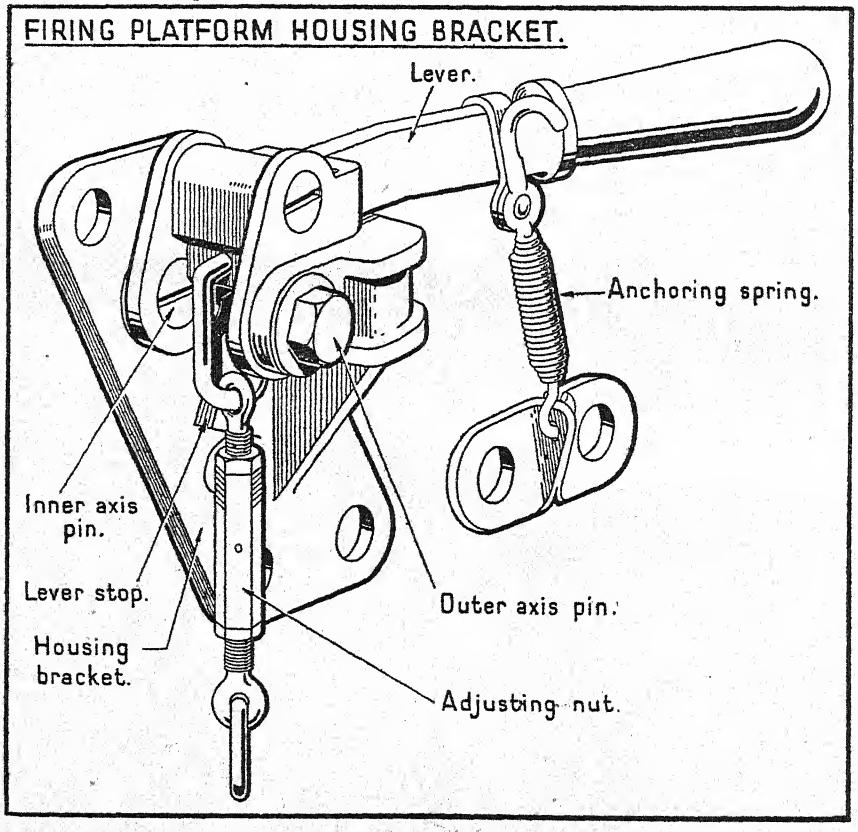

FIG. 12

Riveted to the side brackets of the trail are housing and steadying brackets for the No. 9 firing platform. The front steadying bracket is riveted to the left side bracket, and the rear bracket to the right side bracket of the trail and bear against the flange of the platform and prevent excessive end play which would strain the chains of the housing brackets, so tending to break them.

Chains of later design differ principally from the previous pattern in being shorter and having an eye bolt which, in conjunction with the adjusting nut, retains the firing platform in the travelling position. Chains of earlier design will be converted to conform to the later pattern.

The housing brackets (Fig. 12) consist of a lever and chain pivoted to a bracket and when the levers are pressed down hold the platform tight against the trail. An adjusting nut is interposed between the links of the chains of the housing bracket to take up the lengthening of the chain due to stretch.

A spring clip consisting of a bracket and a spring fastener, with the addition of a lifting hook, is fitted to each side of the trail to retain the firing platform housing levers in the locked position during travelling.

At the rear, on either side of the trail eye bracket, are riveted brackets used in conjunction with the lifting handspikes, each being provided with a locking catch with pawl, and a pedal for quick release to which a Tecalemit lubricator is fitted. A collar, secured in position by a keep pin, retains the spring and plunger of the pedal.

A No. 14 trail eye bracket, which is a steel casting, is riveted to the upper part of the trail at the rear centre ; it is prepared to receive the stem of the No. 44 trail eye which is secured by a nut and bolt. The bracket is designed with two renewable manganese bronze bushes for the trail eye stem and a stop which will limit the rotation of the trail eye, whilst at the top of the trail eye bracket is formed an additional bracket for a lifting handspike, identical to those previously described ; consequently, the handspikes can be applied in three different positions ; in addition, the centre one may also be used to facilitate traversing. Tecalemit lubricators are provided for the bracket and the locking catch pedal.

The No. 44 trail eye permits of partial rotation under normal conditions and, for this purpose, it is formed with two lugs to engage with the rotation limiting stop on the trail eye bracket.

Riveted to the side plates of the trail, at the rear end, are angle plates ; to these plates and to the closing plate is riveted a spade blade and a spade plate. The spade plate is shaped to enter the ground and is strengthened by a throat plate riveted between the spade plate and blade. Between the spade blade and the throat plate is riveted a renewable spade tip.

Two lifting handles are riveted to the upper surface of the spade blade, whilst plates for carrying the spade box, used in conjunction with the firing platform, are also secured to the side of the spade blade.

Various fittings are provided on the trail brackets to carry such stores as are required for the service of the gun.

The *Mark I* No. 2 trail is mainly a welded structure whereas the No. 1 is riveted, but it is otherwise generally similar to the No. 1 with which it is interchangeable.

WHEELS

No. 14 pneumatic wheel (left).

No. 19 pneumatic wheel (right).

No. 14 pneumatic wheels are being converted to No. 19 by replacing the present studs and nuts having left-hand threads, with others having right-hand threads. Eventually No. 19 pneumatic wheels will be fitted to both sides of the carriage.

The wheels (Fig. 13) are of the F.B.R. steel disc type, 5 inch by 16 inch, and consist of the following principal parts :—

No. 2 anti-friction wheel hub (for left wheel).

No. 24 anti-friction wheel hub (for right wheel).

Each comprising a brake drum, brake shoes, brake shoe cam, brake shoe fulcrum pin, stub axle and brake drum cover plate.

No. 10 detachable wheels, comprising a wheel disc, wheel rim and pneumatic tyre.

The No. 2 and No. 24 anti-friction wheel hubs are used in conjunction with the No. 14 pneumatic wheel (left) and No. 19 pneumatic wheel (right) respectively ; they differ only in the threads of the wheel studs and nuts, those on the left side being left-handed threads whilst those on the right side are right-handed threads. The studs and nuts are stamped L or R accordingly, and it is of the utmost importance that the hubs should be assembled on the left or right side of the carriage as indicated by the letter.

It must be clearly understood that the use of the words LEFT and RIGHT to

distinguish one wheel from the other of a pair is always determined by reference to the " travelling front " and not to the " firing front."

The " travelling front " is the direction in which the equipment is moved, with

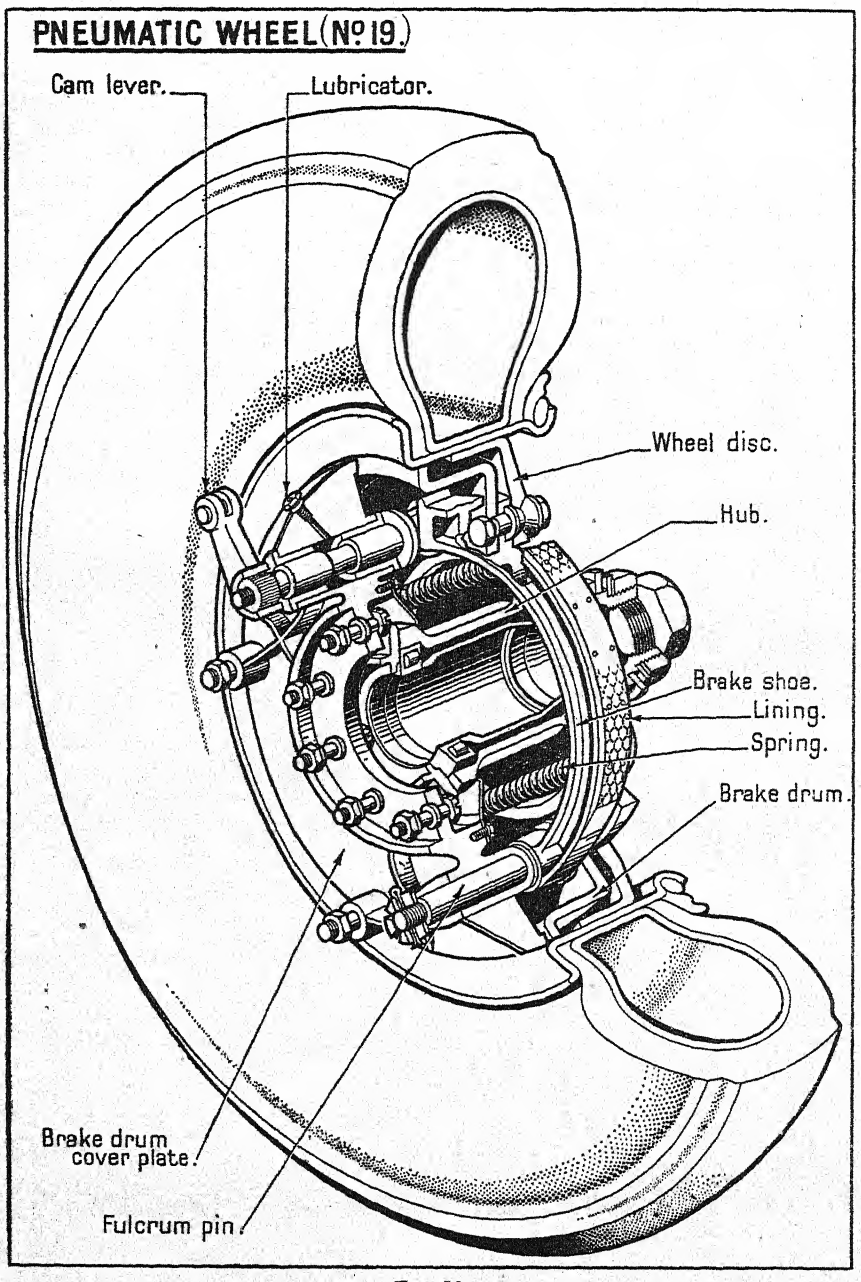

FIG. 13

the trail leading, when limbered up. The " firing front " is the direction in which the muzzle is pointing when the equipment is unlimbered and in action.

Thus, the left wheel is always to be on the near side at the left hand of an observer who is standing at the muzzle and looking towards the trail.

The **anti-friction wheel hubs** are steel cylinders with external flanges prepared with eight holes for the studs of the disc and brake drum. Internally they are formed with bearings and shaped to receive inner and outer roller races, the inner bearings being rigid parallel roller journal bearings and the outer, Hoffman bearings. A distance sleeve, of steel, the outside faces of which are both flat and parallel, is placed between the two bearings to keep them in position, whilst the inner face of the hub is prepared for six screwed studs with hexagon nuts and spring washers to secure a retaining plate with an oil seal ring.

The outer face is prepared for four screwed studs with hexagon nuts and spring washers for the attachment of a cap with fibre washer. The cap carries a No. 5 drag washer, distance collar, locking plate and securing nut ; it is also screw-threaded internally and fitted with a phosphor bronze oil plug with a fibre washer.

The **brake drums** for the wheels are of steel, or alternatively of malleable cast iron ; they are attached to the external flange of the hub by means of eight slotted nuts with split pins, and prepared internally as a bearing surface for the brake shoes. Each drum is provided with a pair of malleable cast-iron brake shoes with non-metallic linings. Attached to each pair of shoes at each end are return springs, their functions being to retain the shoes in position and to pull them clear of the drum as the brake is being released.

The **brake shoe cams,** of steel, are each fitted with two bushes, and function at one end of each of the two brake shoes. The cams are connected to the cam levers of the brake operating gear by means of a nut, spring washer and a plain washer.

The **brake shoe fulcrum pins,** of steel, are fitted to the brake drum cover plates and held in position by fulcrum pin collars, secured by slotted nuts, washers and keep pins to the flange formed on the stub axle supporting brackets.

The **stub axles,** left and right, are steel arms shaped to receive the wheel hubs ; slotted nuts, D-washers and keep pins are provided at the small ends of the axles to retain the hubs in position. The stub axles are flanged at their inner ends and secured, together with the brake drum cover plates, to the face of the stub axle supporting brackets by eight equi-spaced coupling studs. The inner and outer bearings for the roller races are to suit the rigid parallel roller bearings and Hoffman bearings, respectively.

The **brake drum cover plates,** of aluminium, are circular in shape and secured to the outer face of the stub axle supporting brackets by means of eight coupling studs with slotted nuts, spring washers and keep pins. A projection at the front centre is prepared for a phosphor bronze cam bush to take the cams of the brake shoes, whilst at the rear centre is a circular hole and a collar for the fulcrum pin of the brake shoes. A steel cover is positioned against the outer face of the cover plate to prevent oil splashings reaching the brake shoe linings should the oil seal fail. The cover is secured by eight set screws. A lubricator is fitted to the projection of the cover plate to lubricate the brake shoe cam. A mud scraper is secured to each cover plate by means of two bolts with spring washers and nuts.

The **No. 10 detachable wheel** includes a disc, rim, pneumatic cover and inner tube, and in conjunction with the anti-friction wheel hub forms a complete pneumatic wheel.

The wheel disc, of steel, is designed with a 1¼-inch dish, its outer part being welded to the rim ; it is secured to the wheel hub by eight wheel studs with coned wheel nuts, those on the left side being left-handed threads, whilst those on the right side are right-handed threads, the studs and nuts are stamped L or R accordingly.

The wheel rim, of steel, is of the flat base type and is in three pieces welded together and to the disc, being suitably shaped to carry the pneumatic tyre.

Ten hooks are welded under the curved edges of the rim, five on each side, for attachment of a manhandling drag rope.

The pneumatic tyre is of the commercial low pressure type and consists of an outer cover and inner tube, the dimensions being 9·00 inch by 16 inch (34 inch by 9 inch) ; the inner tube is fitted with a swan-neck valve.

Care and preservation

If proper attention is paid to the care and preservation of pneumatic tyres and tubes considerable mileage will result. This mileage will not, however, be realized unless special precautions are taken against deterioration not due to fair wear and tear.

Vehicles and wheels should not be washed while the tyres are deflated. Water, though harmless to rubber, should not be allowed to reach the canvas casing of the tyres.

Frequent inspection of tyres is essential and any cuts observed will be immediately treated by removing the grit, flint or glass, cleaning the adjacent rubber and filling the cut with vulcanizing material. Otherwise, a small cut will develop into a large one and admit water which will rot the canvas inner structure of the tyre.

When fitting a tyre and tube to a wheel, a liberal use of french chalk on the tube will minimize the effect of rubbing between the tyre and the tube. The maintenance of correct inflation pressure is also essential for the same reason.

It is especially important that tyres should be maintained at the correct pressure, as running on under-inflated tyres on roads or hard cross-country ground, injures them and tends to harm the wheel rims, axle roller bearings and springs. Pressure should be frequently tested by means of the tyre pressure gauge and if pressures have been temporarily reduced to assist in traversing sandy or other soft loose surfaces, they must be raised to the correct pressure immediately the soft ground has been passed.

Tyres should be constantly maintained at a pressure as near 35 lb. per sq. inch as is practicable (run-flat 20 lb. per sq. inch).

The spare wheel, with its tyre and tube, must always be ready for immediate use and the correct tyre inflation pressure must be maintained.

Rubber deteriorates rapidly in tropical climates. Special precautions must, therefore, be taken by storing spare tyres and tubes in the dark and, if possible, in an even temperature. Water, exposed in semi-porous containers in gun parks and stores, renders the atmosphere moist and assists in reducing the rate of deterioration.

When vehicles are parked in the open every precaution must be taken to protect tyres from the direct rays of the sun.

With mechanical power inflation pumps, care should be taken to avoid over lubrication of the pump, resulting in the possible injection of oil or oil mist into the tube. To avoid this, the pump should be operated for a few strokes to discharge any oil from the delivery pipe before connecting it to the tube valve. Oil, grease and tar are deadly enemies of rubber and must be removed with a little petrol as soon as their presence is discovered. For this reason the floors of gun parks and garages must be kept scrupulously clean and free from oil or grease.

For more detailed instructions regarding the care and preservation of rubber tyred wheels, *see* the " Manual of Driving and Maintenance for Mechanical Vehicles (Wheeled)."

Every precaution must be taken to ensure that the wheel hubs are on the correct side of the carriage. The right wheel, the studs and nuts of which are stamped R, is always to be on the offside at the right hand of an observer who is standing at the muzzle and looking in the direction of the trail.

Frequent attention to the tightness of wheel nuts is essential, particularly before leaving the gun park and during halts on the march. It is most important when mounting a detachable wheel that the securing nuts should be *gradually* and *evenly* tightened, each pair being taken in successive rotation and in the consecutive order, the wheel concerned being jacked up clear of the ground until the operation has been completed.

The nuts should be tightened daily but when the equipment is new, or the wheels have been recently exchanged, the nuts should receive more frequent attention until it is found that the wheel has bedded down.

BRAKE OPERATING GEAR

The brake operating gear (Fig. 14) is operated by a hand lever positioned on the right side of the carriage and consists principally of the following parts :—

Hand lever, release lever, ratch quadrant, ratch pawl, carrying-shaft brackets, pull rods, distance collar and cam levers.

The **hand lever,** of steel, consists of a lever, cross-shaft and three plates or pull-rod levers all inter-connected by welding.

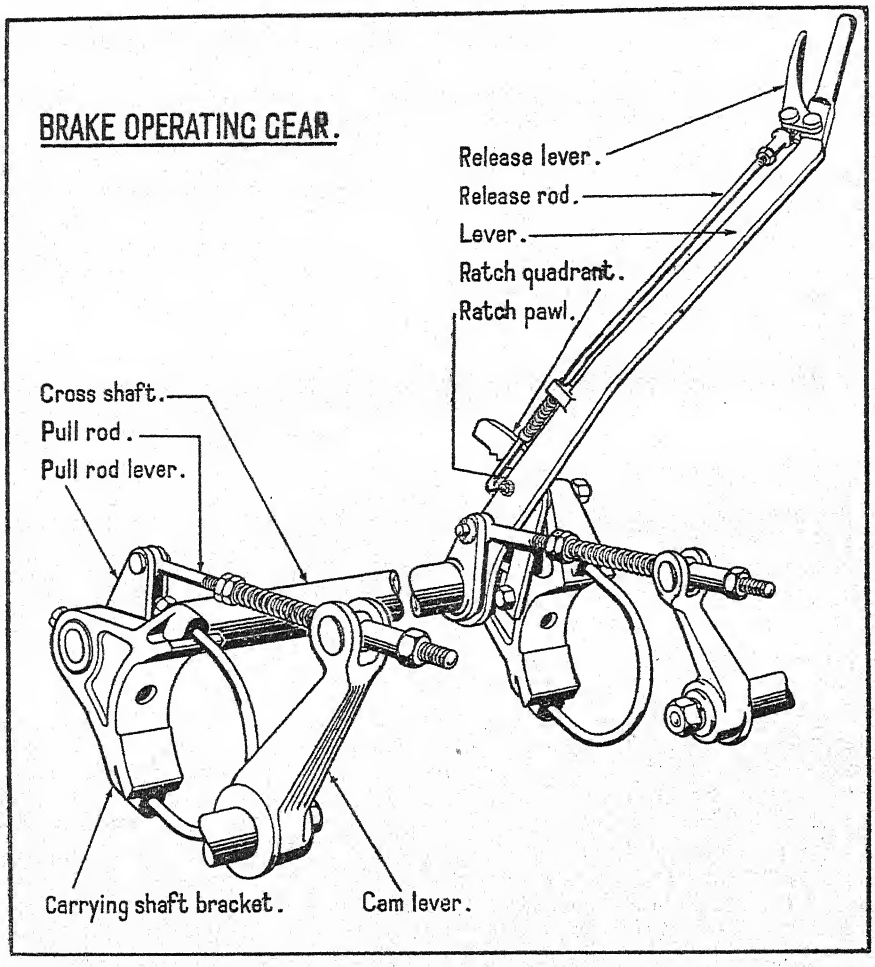

FIG. 14

The **lever** is a flat bar which is cranked and formed circular at its upper end to form a handle. Towards the lower end of the handle a hole is bored for the reception of the axis pin of the release lever, whilst at the lower end of the lever a projection is formed and bored for the release rod to pass through ; below this projection a hole is bored and screw-threaded to receive the axis screw of the pawl. The extreme lower end is bored to pass over the end of the cross-shaft, where it is welded in position.

The **cross-shaft** is a circular steel tube which carries the hand lever and the three plates or pull-rod levers, the shaft being held in brackets on the crossbar.

The **plates or pull-rod levers** are pear shaped and bored at their lower end to pass

over the cross-shaft and at their upper end to receive the connecting pin of the pull rods. One plate is welded at approximately ½-inch from the hand lever and the other two at approximately the same distance apart, on the left hand end of the cross-shaft.

The **release lever,** consists of a lever, rod and spring.

The **lever,** of gunmetal, is an L-shaped casting forked at its lower end and bored with two holes for the reception of its axis pin and the axis pin of the rod.

The **rod,** of steel, is formed at its upper end with a screw thread for the attachment of a connection whereby the rod is attached to a lever by an axis pin. Towards the lower end, below the projection on the hand lever, a collar is welded to the rod, between which, and the projection, is placed a spiral spring. The extreme lower end is bent L-shaped and bored to receive a split pin. The rod passes through the pawl and is secured by the pin. The spring is of circular steel wire of standard pattern.

The **ratch pawl,** of steel, is a small flat lever with a hole bored at one end for the release rod and a hardened tip at the other to engage the teeth of the ratch quadrant, whilst a boring in the centre is for the reception of the axis pin.

The **ratch quadrant,** of steel, is an inverted L-shaped fitment, the long arm of which has two holes for the reception of the bolts securing it to the right carrying-shaft bracket, the bolts being secured by nuts and spring washers. The shorter curved arm has eight case-hardened steel teeth on its under surface to engage with the pawl.

The **right carrying-shaft bracket,** of steel, is shaped to fit against the rear surface of the right-hand end of the crossbar.

The face that fits against the bar is recessed to fit over a projection on the bar, the centre of the recess being bored for the reception of a spigot on the projection, this combination being designed to prevent rotation of the bracket on the crossbar. Two holes are bored longitudinally for the U-clips which secure the brackets to the bar. A projection is formed on the bracket and bored axially as a bearing for the cross-shaft, a bronze bush being interposed for which a Tecalemit lubricator is provided. Two further projections are formed and bored axially for a bolt and screw of the ratch quadrant, the bolt being secured by a nut and spring washer.

The **left carrying-shaft bracket,** is similar to the right except that it is left-handed and is not formed with projections for the ratch quadrant.

The **pull rods,** of steel, are formed at their rear end with an eye for attachment between the two plates or pull-rod levers on the left and the plate or pull-rod lever and hand lever on the right of the cross-shaft respectively, through the medium of a connecting pin. They are screw-threaded at their front end for the reception of two lock nuts and a No. 3 adjusting nut; between the lock nuts and adjusting nut is placed a spiral spring and trunnion. The trunnion forms the means of attachment of the rod to the cam lever, the trunnion being bored axially to pass over the threaded portion of the rod. The adjusting nut, of bronze, has an enlarged head for easy manipulation. By rotating the nut, the trunnion is forced along the rod against the action of the spring, taking up any looseness due to wear, etc.

The **distance collar,** of steel, between the outside plate or pull-rod lever on the left of the cross-shaft and left carrying-shaft bracket, should be adjusted on assembly to give easy rotation of the cross-shaft.

The **cam levers,** of steel, are cranked levers, their upper end being forked and bored axially for the reception of the trunnion, whilst their lower end is also bored and formed internally with 48 serrations for attachment to the brake shoe cam and secured by a nut and washer.

Action of brake

By pushing the hand lever towards the muzzle, the cross-shaft and plates or pull-rod levers being welded to the hand lever, must rotate, imparting a pull on the

pull rods, and through the medium of the trunnions and cam levers a rotary movement is given to the cams of the brake shoes. The cams cause the brake shoes with their non-metallic linings to move about the fulcrum pin, thereby expanding the shoes against the internal diameter of the brake drum attached to the wheel hub, thus applying the brake to both wheels. The pawl engages the nearest tooth on the ratch quadrant and retains the brake in the ON position.

To release the brake, press the hand lever towards the muzzle to take the weight off the pawl and grasp the release lever to disengage the pawl. The hand lever is then operated in a similar manner, being drawn towards the trail eye. As the pressure on the brake shoes is released, the return springs attached to the shoes compress and pull the shoes clear of the brake drums.

Care and preservation

The brake operating gear will be inspected periodically and adjusted to take up wear. Means for adjusting the gears are provided through rods with hexagonal nuts which connect with the lever operating the brake cam. Rotating the hexagonal nuts in a clockwise direction will take up any looseness due to wear and consequently adjust the brakes for keener action.

NO. 7 CRADLE CLAMP

The cradle clamp (Fig. 15) provides the means of locking the cradle to the trail when travelling, thus preventing any undue stress being thrown on the elevating and traversing gears.

It consists mainly of a stay, retaining catch and locking plunger.

The **stay,** of steel, is of H-section, the left end being bored vertically for the reception of a bolt which forms a hinge pin, hinging it to a bracket secured to the left trail bracket. The right-hand end is recessed longitudinally to receive the locking plunger and screw-threaded for the reception of a bush which secures the plunger in position. This recess is bored at right angles with a rectangular hole for the stop of the locking plunger. A small projection is formed below the boring which is recessed and screw-threaded from the front to receive a release lever stud, the stud being retained by a split pin. A Tecalemit lubricator is fitted in the recess for lubricating the locking plunger.

On the upper surface of the stay is formed a hook projection which engages with the clamp bracket of the cradle. To the left of the hook is an elongated recess in which fits a pawl, the pawl pivoting about a pin which passes through a boring in the stay from front to rear. A drain hole is provided in the bottom of the recess to prevent the accumulation of rain water. Leading to this recess from the under side is another boring in which fits a plunger. A Tecalemit lubricator is fitted in the boring for lubricating the plunger.

The **retaining catch** comprises a pawl and spring-loaded plunger.

The pawl is a small steel lever which is bored about its centre to receive the pin. A small projection is formed at its left end to act as a stop, thus limiting the upward movement of the pawl. The other end is shaped to fit against the side of the projection on the cradle-clamp bracket. The pawl is machined on the under side to bear against the plunger. The axis pin has a flanged head to which is fitted a Tecalemit lubricator. A spiral groove is cut around the shank of the pin for lubricating purposes, whilst leading from the bottom of the lubricator recess to the oil groove on the exterior is a small hole to distribute the lubricant. The pin is retained by a split pin.

The **plunger,** of steel, has a flanged conical head, the tip of which is flattened to bear against the pawl. The lower end of the plunger is bored for a keep pin to secure it to the stay. Between the head of the plunger and the interior boring of the stay is interposed a spiral spring to keep the plunger up to its work.

The **locking plunger** comprises a plunger, stop and release lever.

The plunger is a small steel spindle which is flanged to form a bearing surface for one end of its spring, whilst above the flange it is machined to enter a recess in the bracket secured to the right bracket of the trail. Below the flange it is machined in two diameters, the larger to fit the interior of the spring and the smaller to fit in a hole in the stop. The spiral spring fits over the spindle portion and takes a bearing against a shoulder in the recess provided for it and the flange on the plunger.

The plunger is retained in its recess by the stop and a rolled bronze bush, the bush screwing into the end of the stay where it is secured against rotation by a grub screw.

The stop, of steel, is shaped at one end to engage the release lever and at the other it is bored to pass over the end of the locking plunger where it is secured by a keep pin.

The release lever is the means of releasing the plunger from the bracket in the trail when necessary, and consists of a small lever with a thumb piece formed at its upper end and a hole bored in the lower end to pass over a stud, where it is secured by a slotted nut, plain washer and keep pin. An elongated hole is bored about the centre to pass over the end of the stop.

To lock or unlock the cradle

The end of the cradle clamp is released from its housing bracket on the left side

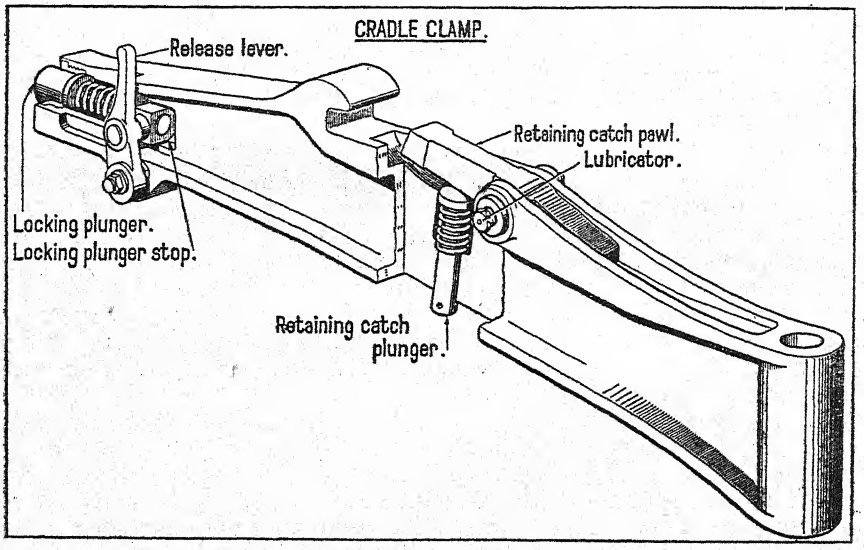

FIG. 15

bracket of the trail and swung into the travelling position where it is held by a locking plunger engaging a recess in a bracket on the right side bracket of the trail.

The cradle is then traversed to approximately 3 degrees right traverse and elevated until the U-piece of the bracket on the under side of the cradle bears on the clamp. The cradle is then brought to zero traverse, when the catch retaining pawl automatically locks the cradle in the travelling position.

Unlocking is achieved by giving the release lever of the locking plunger a sharp pull to the left, thus releasing the locking plunger from its recess in the bracket and then swinging the stay into the housing bracket on the inside of the left side bracket of the trail.

SHIELD

The shield (Fig. 16), of bullet-proof steel, is provided for the protection of the gun detachment and carriage.

It consists of a main plate, to the top of which is hinged a flap plate, the latter being folded down when travelling.

The main plate is bolted to stays which are secured to the trail by means of rivets.

The stays consist of L-shaped frames with upper and lower brackets. Before bolting the brackets to the main plate, the shield is positioned by means of a pintle which screws into the bottom of the lower bracket. In future the stays will be of welded construction and will replace those depicted in Fig. 16.

To reduce vibration during travelling and firing, stiffening angles are provided at the rear of the main plate, above and below the opening for the gun, also a stop plate on the right front of the main-plate for the tip of the shovel.

A large opening is provided in the centre of the main plate to permit movement of the gun and cradle in elevating and traversing, and shaped semicircular at the top to conform with the gun. A coned portion is cut away at the bottom centre of the

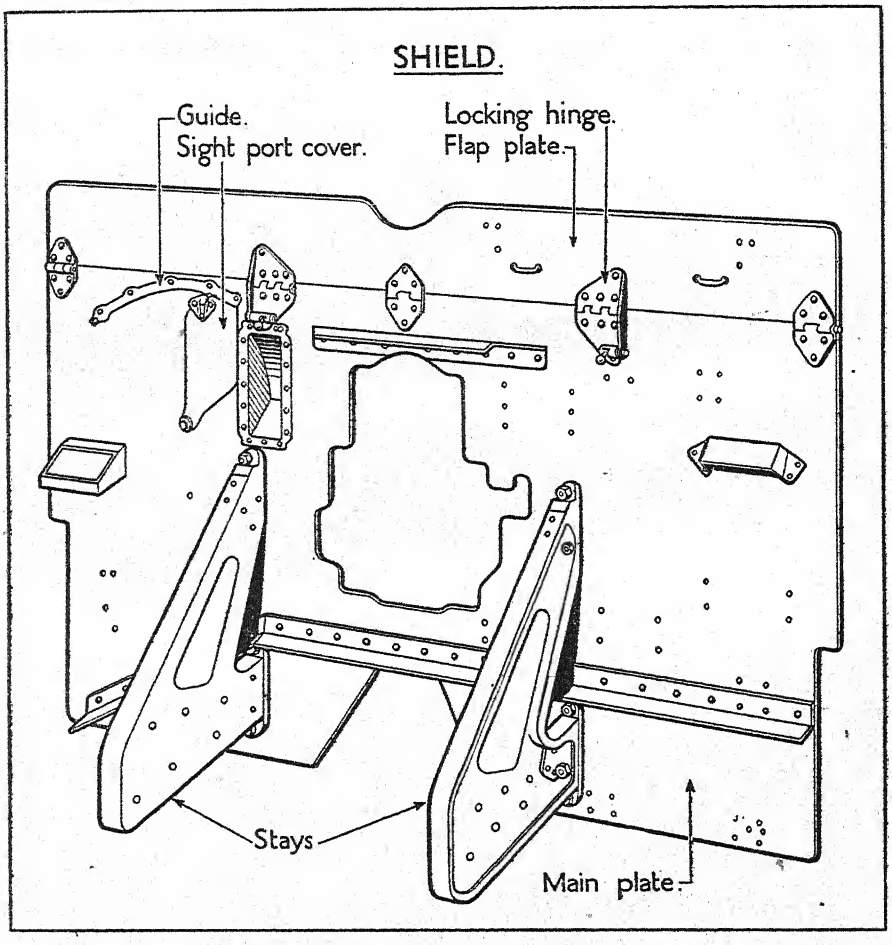

FIG. 16

plate to give clearance to the towing shackle at the front of the trail and on each side is a cut-away portion to allow for the use of the manhandling dragropes (not shown in Fig. 16).

To the left of the large opening are two smaller openings, the nearest for the operating arm of the sight, whilst the other gives views to the front for the telescope.

The opening for the sight operating arm is closed at the front by means of cover and supporting angles which are riveted to the main plate ; this permits movement of the sight arm without fouling the shield. The opening for the sight is closed by a port cover which consists of a plate with bracket, spring plunger and axis pin.

The plate, of steel, completely covers the port and pivots at its lower end on an axis pin ; it has three borings at the top to take the bracket.

The bracket, of steel, is riveted to the upper part of the plate by three rivets the heads of which are made flush with the face of the plate, so as not to obstruct the movement of the plate when moved to the open or closed positions. A hole is bored in a projection at the top for the reception of a spring plunger which operates in conjunction with a guide riveted to the main plate.

The plunger, of steel, is a small spindle screw-threaded at its outer end for the plunger knob, whilst the head is shaped to fit into recesses at each end of the guide. Formed towards the head is a flange which acts as a bearing surface for one end of the spring, the inner surface of the bracket forming a bearing for the outer end of the spring. The plunger is manipulated by means of a gunmetal knob.

The axis pin, of steel, fits in a boring at the bottom of the plate. It is screw-threaded at one end to take a single turn spring washer and nut which secures it to the plate, the outer end being fitted with a Tecalemit lubricator.

The sight port cover guide, of steel, is a semicircular plate riveted to the main plate and acts as a guide for the sight plate when moving the latter to the open or closed positions. It is retained in these positions by means of the bracket plunger fitting in recesses at each end of the guide. A small stop is fitted to the flank of each recess to limit the movement of the plate when opening or closing.

Just below the guide of the sight port cover a xylonite plate is positioned on which zero line readings can be recorded for use by the gunlayer.

The flap plate fits on top of the main plate ; it is formed semicircular at its top centre to conform with the shape of the gun when folded down for travelling. It is hinged to the main plate by three plain hinges, one at each end and one in the centre, in addition, a left and right locking hinge is positioned on either side of the centre plain hinge.

The plain hinges are in two parts, Part I and Part II. Part I is riveted to the flap plate and Part II to the main plate, the parts being secured by a pin.

The locking hinges are also in two parts, Part I and Part II. Parts I and II being riveted to the flap plate and main plate respectively, the parts being secured by a pin.

Part II is supplied with a locking plunger with handle which screws into it ; the head of the plunger engages in a recess in a stem on Part I, thereby locking the flap plate when in the firing position.

In front of the flap opposite the locking hinges are riveted flap locking brackets ; projections on the brackets are bored for the plungers on the locking hinges to enable the flap to be locked in the travelling position, consequently, it will be seen that the locking plunger serves a dual purpose.

The shield is provided with suitable fittings for the carriage of various articles of equipment, see page 241.

A holder to contain :—

Maintenance Manual
Recoil system history sheet
Carriage history sheet.
Memorandum of examination and Gun record book (C.I.A. form 472A).

is positioned between the shield and bracket carrying apparatus, illuminating sight. The bracket is extended by an angle arm.

SADDLE

The *Mark I* No. 1 saddle is the traversing portion of the carriage and forms an intermediary between the trail and cradle, and consists of inner and outer side plates and a right side plate, connected at the front by a transom and also at the front and bottom by a bottom plate. The whole is strengthened by various channels, stiffening plates and angles. The upper edge of the bottom plate at the front is bent downwards. Riveted to the edge is a leather pad to form a depression stop, whilst

to the rear of the transom is riveted an elevation stop. A central hole is cut in the bottom plate to coincide with a similar hole in the transom to receive a pivot which is secured to the transom and bottom plates by stiffening plates. Two hand holes are cut in the transom to allow access to the interior. On each side of the lower face of the bottom plate are rubbing plates secured by countersunk rivets, whilst an inscription plate of gunmetal is secured by screws to the left outer side plate. A traversing stop is riveted to the left side plate, in front. The inscription plate shows the description and Mark of carriage, registered number, year of manufacture and contractor's initials.

To the top of the side plates are riveted the left and right trunnion bearing brackets of nickel steel. They are semicircular in shape and prepared for the reception of manganese bronze liners to act as half bearing surfaces for the trunnions to the cradle ; the liners are secured to the brackets by four screws. The brackets are bored axially

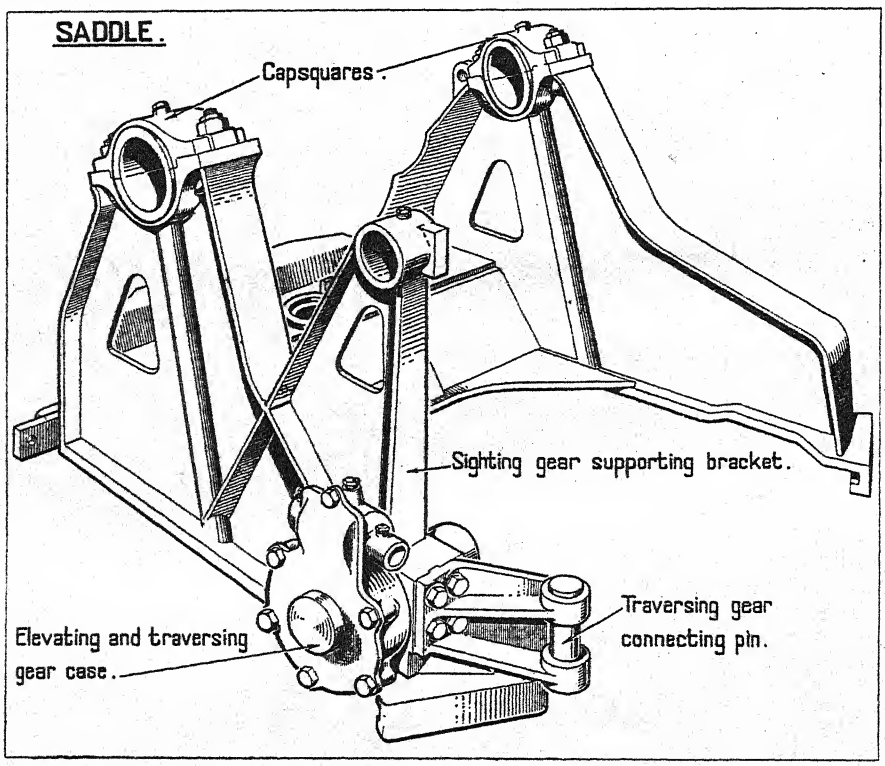

FIG. 17

at each end to receive the capsquare pin, whilst a circumferential groove is cut internally in these borings to receive a projection on the capsquare pin spring.

The right trunnion bearing bracket has a projection at the top front, which is bored for the securing pin of the actuating rod of the cut-off gear.

The capsquares fit on top of the trunnion brackets. They are of steel, semi-circular in shape to fit over the trunnions and fitted with a similar liner to the trunnion bearing brackets. At each end are projections, bored axially to receive the capsquare pins by which they are secured to the trunnion bearing brackets. In the centre a hole is bored and screw-threaded for a Tecalemit lubricator.

The capsquare pins are cylindrical and flanged at one end, the flange and upper surface being recessed for a flat spring, the latter being retained by a screw. Formed on the spring is a small projection which fits into the groove in the trunnion bearing bracket thereby retaining the pin in position.

To the rear end of the inner and outer left side plates is riveted the elevating and traversing gear case which forms the housing for the gears, a supporting bracket for the sighting gear and a bracket for the connecting pin of the traversing gear.

The sight supporting bracket has a hole bored axially to receive the sight pivot; the boring is for large and small phosphor bronze bushes.

Towards the rear a forked projection is formed to receive the connecting link of the traversing gear, the projection having a vertical boring for the connecting pin.

The case is bored axially to receive the arc pinion, a phosphor bronze bush being interposed, whilst bored longitudinally are bearings for the worm spindle of the elevating gear, the bearings being bushed with long and short phosphor bronze bushes.

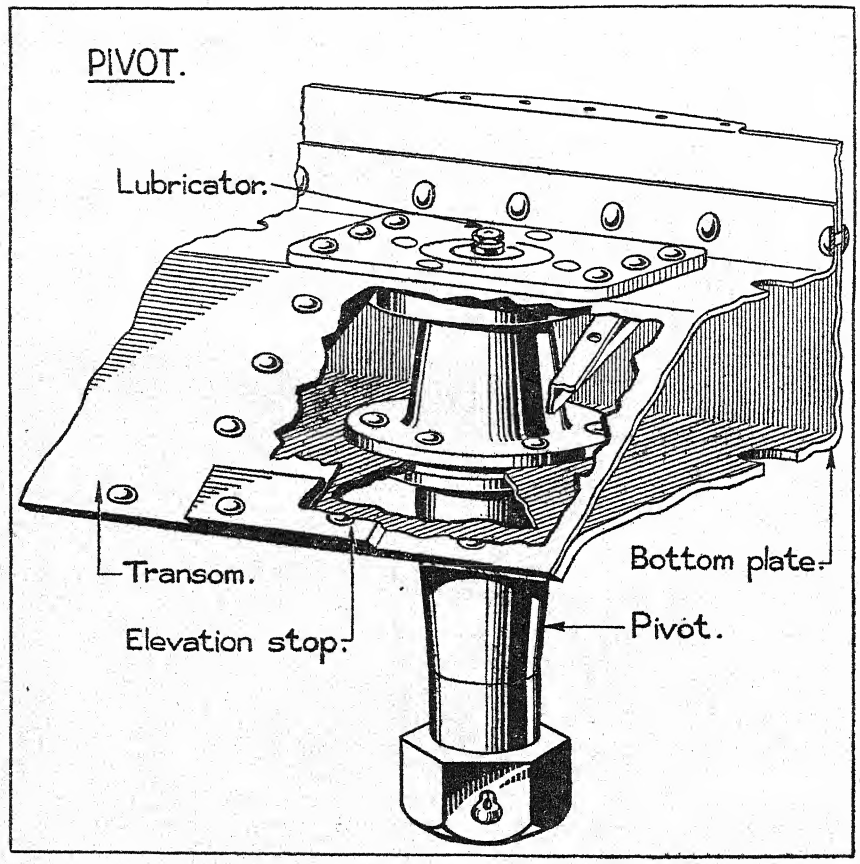

FIG. 18

Two Tecalemit lubricators are provided for the elevating worm shaft and one each for the sight supporting bracket, the arc pinion and the traversing gear connecting pin.

The gears are protected from damage and ingress of dirt or grit by an aluminium cover plate which is secured to the case by six screws.

Formed on the under side of the case is a clip which engages the guide formed on the trail.

To the rear end of the right side plate is riveted the right rear clip which is shaped to engage the guide on the trail and in conjunction with that on the elevating and traversing gear case prevents the rear of the saddle lifting on firing.

Secured to the transom and bottom plate is a steel pivot (Fig. 18). It is formed at the top with two flanges, the flanges and plates being riveted against stiffening plates. The pivot is bored internally for most of its length, the upper end being

screw-threaded for a closing plug, the latter being fitted with a Tecalemit lubricator. Externally at its lower end it is screw-threaded for the pivot nut, by means of which the saddle is secured to the trail, the nut being secured by a keep pin. Above the pivot nut and below the lower flange two surfaces are machined to enter the bushes in the transom and bottom plate of the trail, whilst holes are drilled axially to allow for the passage of lubricant from the interior of the pivot to the bearings.

The **No. 4 saddle** (Fig. 17) is a strengthened pattern saddle and supersedes the No. 2, and is an alternative to the Nos. 1 and 3.

It differs from the No. 2 in the increased thickness of the plates, and from the Nos. 1 and 3 in being of welded construction.

In future, the No. 4 saddle will be modified by having the front plate cut away in order that Nos. 4 and 5 cradles will not foul in elevation, thus ensuring interchangeability.

The **No. 3 saddle** is a riveted structure similar to the No. 1, differing only in slight manufacturing details.

The **Mark I** No. 2 saddle is mainly a welded structure, whereas the No. 1 is riveted, but it is otherwise generally similar to the No. 1 with which it is interchangeable.

TRAVERSING GEAR

The traversing gear (Fig. 19) of the screw and nut type, is situated on the left side of the carriage on a pivot bearing carried in a supporting bracket riveted to the trail, and actuated by a hand wheel. By means of this gear the saddle, with cradle and gun, is traversed to the extent of 4 degrees right or left of a centre line without disturbing the trail.

The gear consists principally of the following parts :—

Bearing pivot, traversing screw, traversing screw cover, connecting link or actuating nut, hand wheel and anti-friction washer.

The **bearing pivot,** of steel, is fitted with a phosphor bronze bush and is secured to the pivot bracket by means of a slotted nut, plain washer and keep pin. Its function is to support the traversing screw. A Tecalemit lubricator is fitted to the pivot.

The **traversing screw,** of steel, has a square thread cut at one end to engage with the connecting link, whilst at the opposite end four splines are formed to receive the traversing hand wheel ; it is also threaded to take a slotted nut with plain washer and keep pin to retain the hand wheel in position. A plain enlarged diameter on the screw is machined to take a bearing in the bearing pivot, whilst just in front of this plain portion is cut a screw thread to take the cover.

The **traversing screw cover,** of manganese bronze, is held by a keep pin and forms the nut to secure the traversing screw in the bearing pivot, also a protecting cover for the screw, thus obviating the possibility of any dirt or grit getting on to the screw threads at extreme traverse.

The words LEFT and RIGHT, with corresponding arrows, filled in with black wax, are engraved on both sides of the cover, the edge of the cover forming the reader for the scale.

The **connecting link or actuating nut,** is cylindrical in shape and consists of a rolled bronze link with a phosphor bronze bush. The link has a square thread cut internally at one end to engage with the traversing screw, the other end being bored and fitted with a bush, to engage with the saddle by means of a traversing gear connecting pin. A traversing scale is engraved on the upper surface of the link reading from 0 to 4 degrees right and left in multiples of 30 minutes, the graduations, letters and figures being filled in with black wax.

The **hand wheel** is secured to the left end of the traversing screw ; it has an aluminium or gunmetal body and sleeve with a steel collar and spindle.

The **anti-friction washer,** of steel, is placed between the traversing screw cover and the bearing pivot to prevent the cover binding on the face of the pivot.

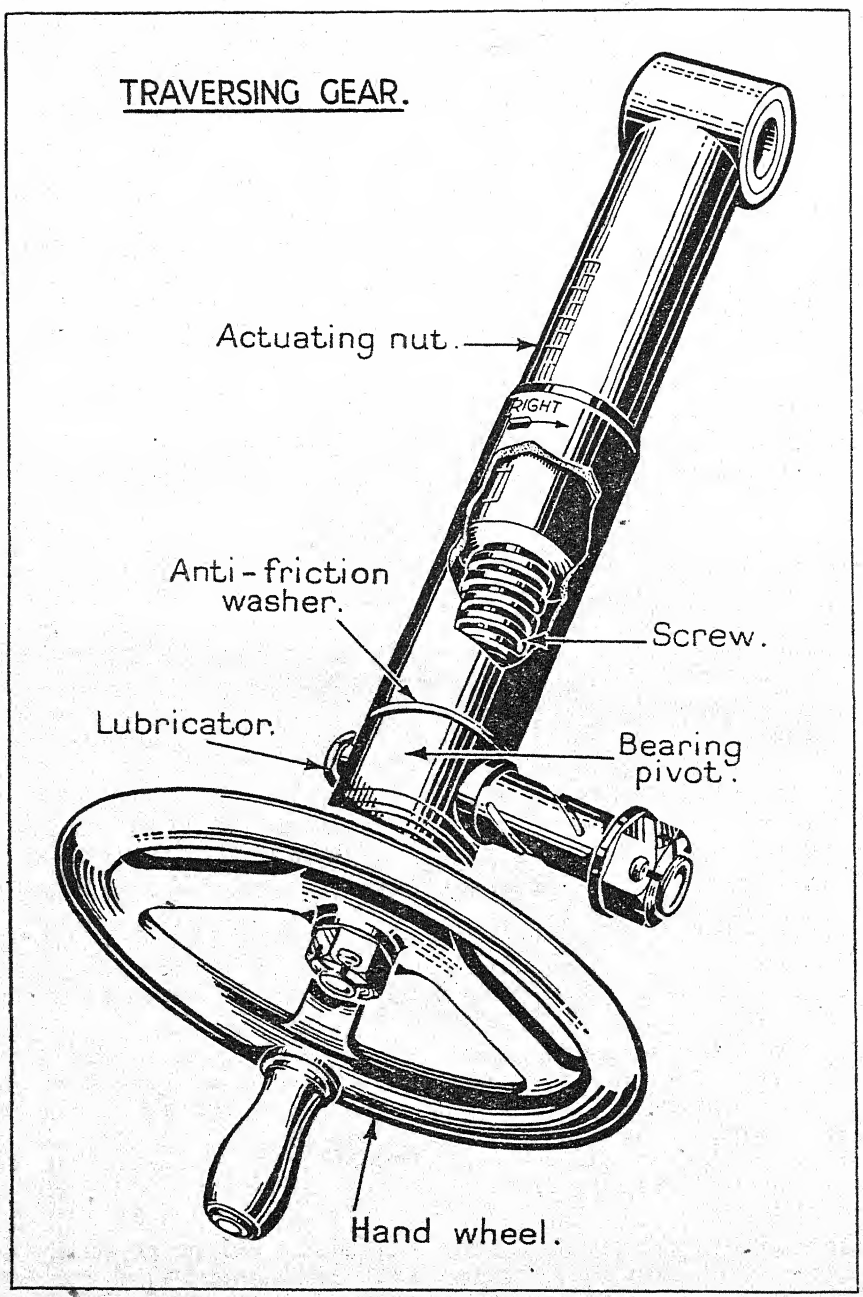

FIG. 19

ELEVATING GEAR

The elevating gear (Fig. 20) is of the worm gear type and is actuated by a hand wheel and carried in a bracket on the left side of the saddle in close proximity to the traversing gear.

The gear consists principally of the following parts :—

Arc, arc pinion, worm spindle, hand wheel, worm and worm wheel.

The **arc,** of steel, is secured to the left side of the cradle by five screws, each screw having a spring washer. The rear of the arc is formed semicircular and has spur teeth cut in it to engage with stub teeth on the arc pinion. Towards the upper end, two holes are bored for the reception of the firing bracket securing bolts, the bolts being secured by slotted nuts and keep pins; above these holes, on the inside of the arc, a recess is bored and screw-threaded for the reception of the axis pin of the

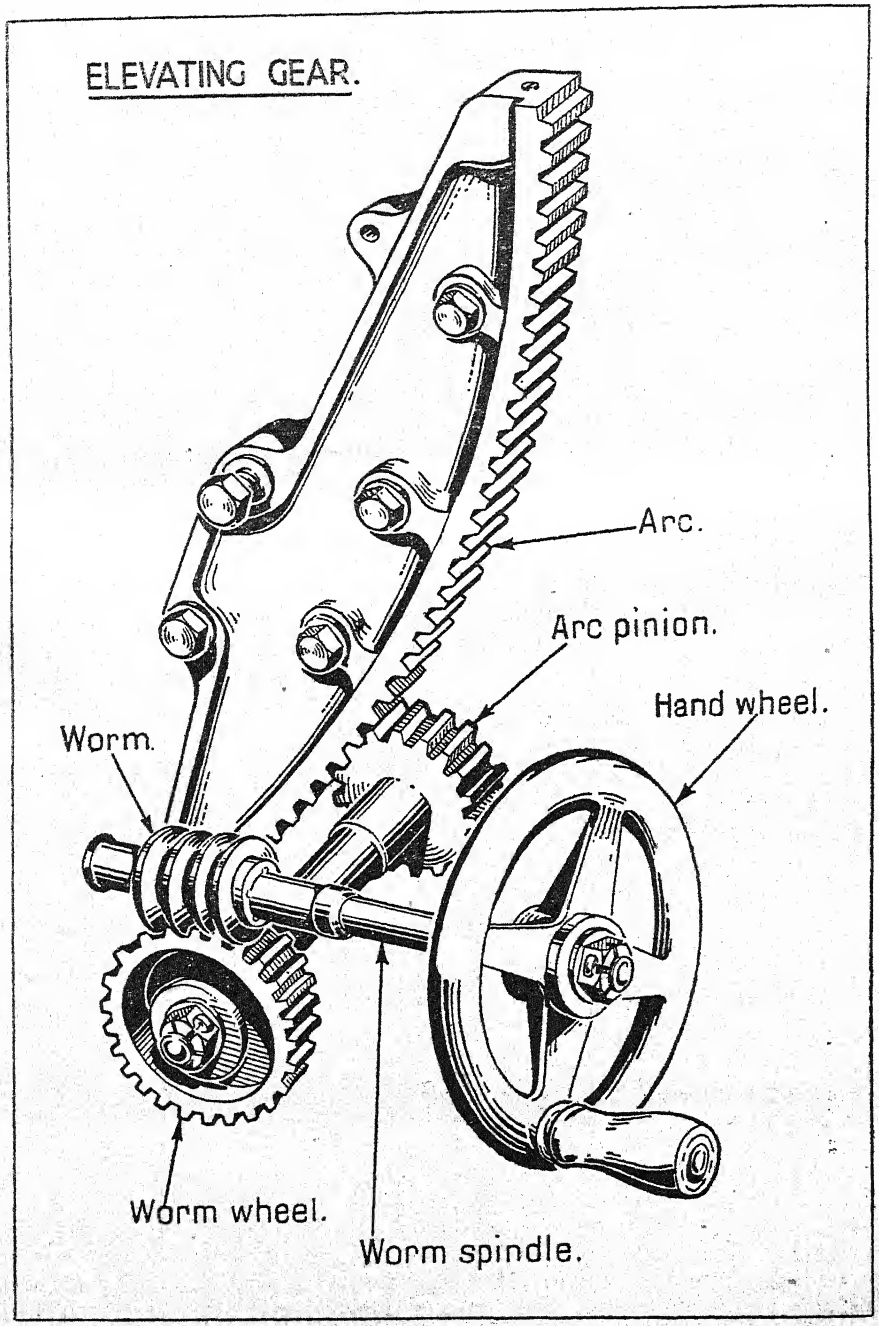

FIG. 20

firing lever and an axial boring through this recess is screw-threaded for a grub screw, retaining the pin in position.

The **arc pinion,** of steel, is formed with a short shaft which is screw-threaded at its outer end to receive a slotted nut and keep pin, also splines for the reception of the worm wheel. About the centre the shaft is machined to fit a bearing in the bracket on the saddle. The pinion is formed with 14 stub teeth which engage with the teeth of the arc. The pinion is placed in position from the inside of the saddle and is secured by the worm being placed over the splines on the shaft from the outside and secured by the slotted nut. The pinion and a portion of its shaft are hollowed for lightness.

The **worm spindle,** of steel, is a short longitudinal spindle carried in bearings formed in a bracket on the left of the saddle. Its inner end is enlarged to form a flange which bears against the bracket.

It is splined near the outer and inner ends for the reception of a hand wheel and worm respectively, also screw-threaded at its outer end for the slotted nut with washer and keep pin that secures the hand wheel in position. The spindle is retained in the bracket by a collar and split pin, the pin passing through a hole bored axially through the collar and spindle.

The **hand wheel** is secured to the end of the worm spindle ; it has an aluminium body and sleeve with a steel collar and spindle.

The **worm,** of steel, fits over the inner splines on the worm spindle and works in conjunction with a worm wheel.

The **worm wheel,** of phosphor bronze, is secured to the splines on the arc pinion and retained in position by the slotted nut of the pinion. The wheel has 25 teeth to engage with the worm on the worm spindle.

A friction device is fitted to prevent creeping of the hand wheel.

Care and preservation

The gears will be kept well lubricated and free from grit ; all arcs, pinions, bevel and worm gears, trunnion bearings, etc., must have the old lubricant removed, periodically, and be thoroughly cleaned before applying fresh lubricant.

On completion of the above, the gears will be well worked through their full range to distribute the lubricant and test the gears.

The gears must be worked at least weekly through their full range.

The traversing gear must be in the central position when travelling and the cradle secured to the clamp.

The gun must not be fired at angles over 20 degrees Q.E. when the shield upper flap is lowered.

FIRING GEAR

The firing gear of the carriage (Fig. 21) is carried at the upper end of the elevating arc, to which it is bolted, and is operated by a firing lever.

The gear consists principally of the following parts :—

Carrying bracket, firing lever, plunger in two parts and axis pin.

The **carrying bracket,** of manganese bronze, is bored at its lower end with two holes to receive the bolts which secure it to the top of the elevating arc, the bolts being secured by slotted nuts and keep pins. Above the two holes is a recess in the front edge of the bracket to receive a Tecalemit lubricator. To the right of this recess and above the securing bolt holes is another boring through which passes the lever axis pin. A lubricating channel is bored from the lubricator recess to the axis pin hole for the passage of lubricant. Above the lubricator is formed a projection which is screw-threaded for the reception of an adjusting screw with lock nut.

The upper edge of the bracket is circular in shape and bored longitudinally for the reception of a plunger. The top edge of the boring is formed flat to prevent the

plunger rotating. Towards the centre of the upper edge, a hole is screw-threaded to receive a Tecalemit lubricator, whilst at the front there is another hole which is screw-threaded to receive a stop screw.

The **firing lever,** of steel, consists of a striker and lever welded together.

The striker is pear-shaped and bored at its lower end for an axis pin, whilst at its upper end a case-hardened lug is formed to actuate the plunger.

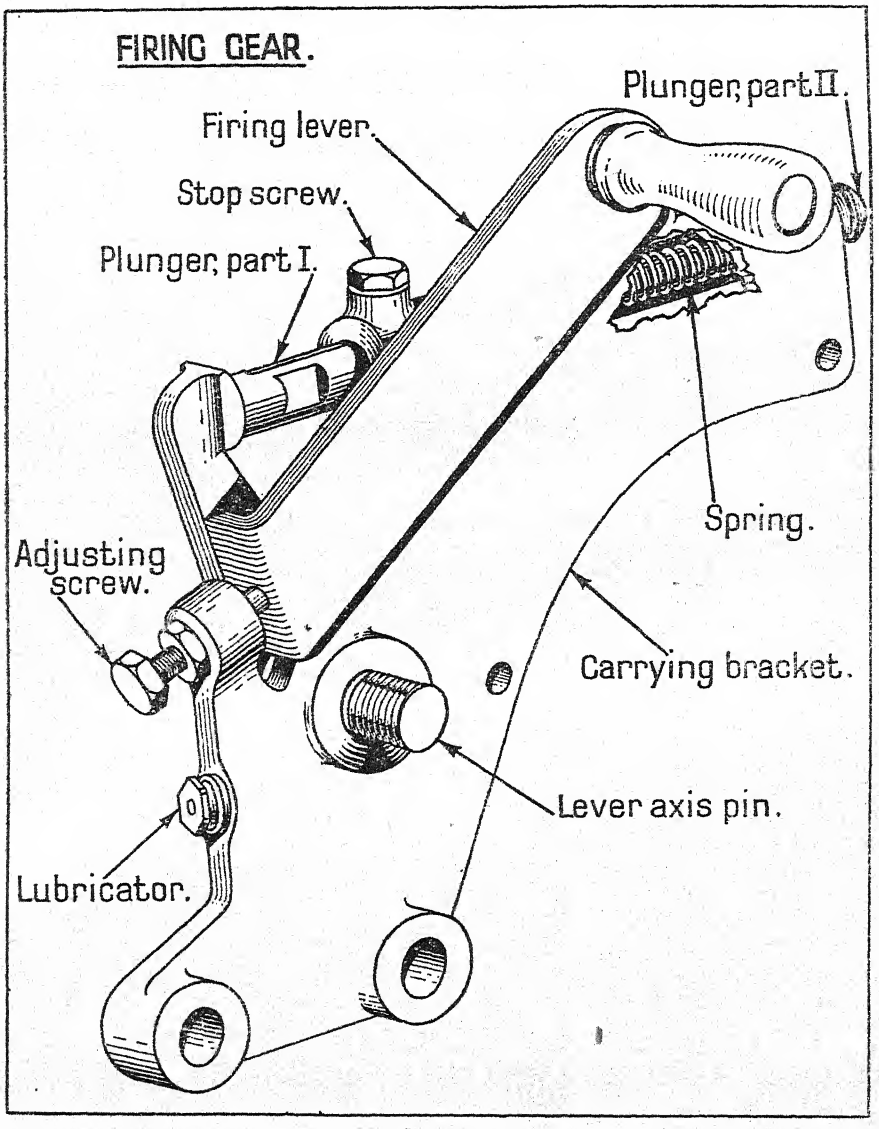

FIG. 21

The lever is L-shaped at its lower end to clear the bracket and welded to the striker portion. The upper end has a boring for the spindle of the handle, the spindle being riveted over after the handle is assembled.

The **plunger,** of steel, is in two parts. Part I is a steel rod radiused at its front end to bear against the striker portion of the firing lever and bored longitudinally and screw-threaded to pass over the end of Part II. A longitudinal groove is cut

in the upper surface of Part I for nearly its full length, in which fits the inner end of the stop screw, whilst a square recess is cut on each side to allow of the application of a spanner to position the groove.

Part II is also a steel rod. It is flattened on the upper surface to coincide with the boring in the bracket. At the front end it is screw-threaded to take Part I and formed with a mushroom-shaped rear end to actuate the firing gear of the gun.

In later pattern plungers, Part II is lengthened, due to the gun being positioned further back in the cradle, by the distance equal to one groove of the cradle thrust collars.

A steel spring, circular in section, passes over Part II and is secured by Part I. The rear end of the spring takes a bearing against an internal shoulder in the bracket.

The **axis pin,** of steel, allows for the rotation of the firing lever. It has a flanged head and is formed hexagonal for the application of a spanner and is machined in two diameters, the larger of which is formed with an oil groove. The inner end of the pin is screw-threaded to fit the recess in the upper end of the elevating arc, whilst just in rear of the screw threads is cut a groove into which engages the end of the set screw in the elevating arc.

The pin is bored longitudinally to within $\frac{1}{4}$ inch of the head and axially through the centre of the oil groove in the larger diameter and through the centre of the smaller diameter. This allows the lubricant to pass from the Tecalemit lubricator in the front edge of the bracket to the working surfaces of the firing lever.

CRADLE

The cradle (Fig. 22) is a trough-shaped structure built up of various fitments, all being riveted together, to carry the gun and recoil arrangements, the whole pivoting vertically in the saddle through the medium of the trunnions. It consists mainly of a casing of nickel steel formed U-shaped, each side being fitted with a guide which extends the whole length and is riveted in position on the interior. The guides are curved inwards at the top and bottom to bear over and under the cylinder block respectively, the surfaces of which are machined to allow the block to slide longitudinally between them. Each guide is bored from the exterior of the casing and screw-threaded to receive Tecalemit lubricators, six on each side, three upper and three lower.

A steel recoil strip is secured by six screws to the upper surface of the left guide. The strip is graduated in inches from 10 to 40, the fives and tens being numbered. Fitting over the strip is a rolled bronze recoil indicator slider which consists of a Part I and Part II respectively. Part I fits on one side of the strip and is engraved with an arrow, whilst Part II fits on the other, the two parts being secured together by a clamping screw with a spiral spring interposed. This system of assembly retains the slider in one position until moved either by a striker secured to the cylinder block or manually. To prevent the slider leaving the strip, a stop screw is positioned at each end of the strip.

On the exterior of the casing, on the right side, at the rear end, is secured a gunmetal instruction plate having raised letters as follows :—

CONTROLLING SPEED OF RUN-OUT.
TO INCREASE, TURN VALVE "R" ANTI-CLOCKWISE.

Towards the rear centre is riveted a trunnion band which is U-shaped and formed with left and right trunnions. The trunnions are cylindrical and have equally spaced lubricating channels on their exterior, whilst the left one is furnished internally with a screw thread for the reception of a sight carrier trunnion. Towards the rear end of the band, on the left side, five recesses are drilled and screw-threaded for the securing screws of the elevating arc.

The sight carrier trunnion is a hexagon-headed cylinder, flanged and machined to pass through the sight operating arm and to retain it in position, a screw thread on its inner end corresponding to the screw thread in the interior of the left trunnion.

At the rear end of the casing on the under side is riveted the cradle clamp bracket which is U-shaped to act as a supporting band and a clip to engage the cradle clamp, whilst a hole is bored at the rear end, towards the right, for the reception of the running-back stop.

Over the front end of the casing is riveted a front band to strengthen the end of the casing and also to form a means of attachment for a front cap. The band is in the form of a rectangle, open at the front and rear, whilst two vertical projections are bored longitudinally to receive the beating face stop and beating face pad.

The stop is a steel mushroom-headed bolt which is screw-threaded to receive a castle-headed nut and keep pin. Fitted between the nut and head are a number of rings of asbestos to form a pad.

Four projections, two on the upper side and two on the lower, are slotted, bored longitudinally and screw-threaded to take the axis screws of the swing bolts which secure the front cap. The swing bolts have a hole at one end for the axis screw and are screw-threaded at the other for a castle nut. A collar is placed over the top of the nut, whilst the end of the bolt is riveted over to prevent loss of the nut.

The front cap encloses the front end of the casing; it is semicircular in shape and formed rectangular on its rear face to correspond with the front band. At each corner of the rectangular portion is formed a projection, cut U-shaped to receive the swing bolts.

An instruction plate is secured by screws to the upper surface of the cap which bears the following instructions in raised letters :—

IMPORTANT

TELL-TALE FACE MUST BE FLUSH WITH REAR END OF SLOT WHEN RECUPERATOR IS CORRECTLY FILLED WITH OIL. WHEN TELL-TALE FACE IS NEAR FRONT END OF SLOT PUT IN MORE OIL WITH SCREW PUMP.

also

IF CUT-OFF GEAR IS DAMAGED, DISCONNECT AND LOCK SEGMENT ON BUFFER ROD AT 20 INCHES RECOIL.

A projection is formed on the right-hand side of the cap which is bored for the reception of a gunmetal bush through which passes the bevel pinion shaft. The projection is prepared for a Tecalemit lubricator. Three holes are bored through the front of the cap, that on the right for the buffer piston rod, that on the left for the recuperator piston rod, whilst the centre one is for the floating piston tell-tale rod. The hole for the recuperator piston rod has a featherway to engage a feather on the rod, whilst the centre hole is screw-threaded internally to receive the screw threads of the floating piston cover.

The hole for the buffer piston rod is bushed with a phosphor bronze bush from the outside to receive the locking lever, and from the inside with the bevel wheel bush of the cut-off gear; the hole is bored and screw-threaded for a Tecalemit lubricator. Immediately opposite this lubricator a hole is prepared for a locking lever stud which is screw-threaded at each end; one end screws into the front cap and is then riveted over and the other receives a hexagon nut and collar; this end is also riveted over after the collar is in position.

Midway between the hole for the tell-tale rod and the buffer piston rod is a semi-circular projection; to this is screwed a recoil indicator plate of brass. The plate is graduated in inches from 10 to 40, in divisions of two inches, each ten being numbered, and reads in conjunction with an arrow engraved on the locking lever. The graduations read in unison with those on the recoil strip on the left guide of the casing, and both should agree at the moment of firing, provided the cut-off gear is set correctly. Should the cut-off gear become damaged the locking lever is set at 20 inches, thereby giving an average recoil for all angles of elevation.

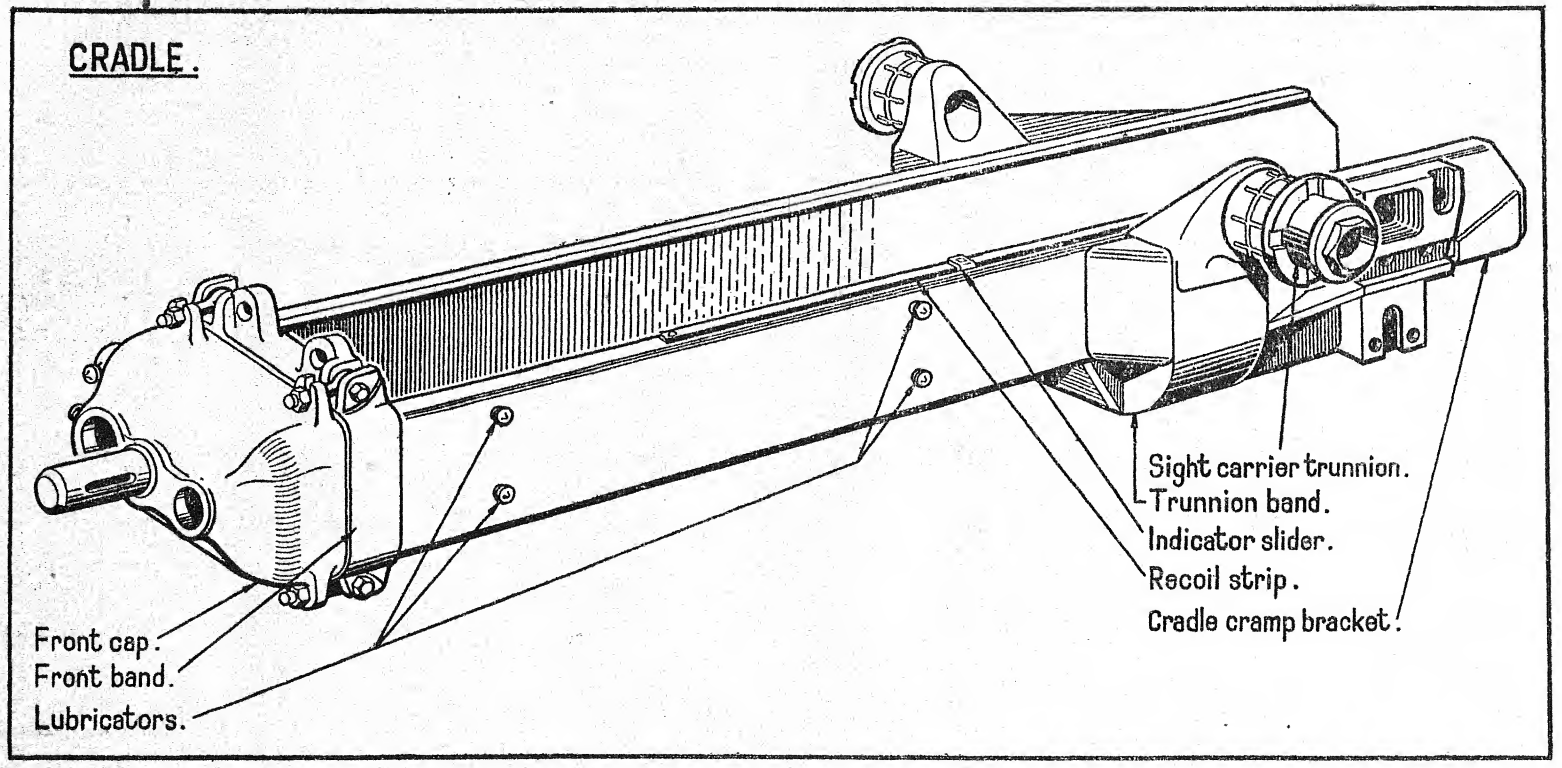
CRADLE.
Front cap.
Front band.
Lubricators.
Sight carrier trunnion.
Trunnion band.
Indicator slider.
Recoil strip.
Cradle cramp bracket.

FIG. 22

A floating piston rod cover, of steel, is screwed to the centre hole in the front cap. It is a hollow cylinder, closed at one end, and formed hexagonal and screw-threaded at the other. A slot, 3·2 inches in length, is cut in the left side; the cover forms protection for the tell-tale rod and the rear end of the slot acts as a reader for the rod.

In the under surface of the front cap a rectangular hole is cut to allow for the glands of the cylinder block to be inspected and, if necessary, adjusted. This hole is closed by a hinged cover and secured by a spring-loaded catch, which is an L-shaped bolt with a ring for opening and closing purposes.

To prevent injury to the gunlayer's hand when operating the firing lever, a steel guard plate is provided in which holes are drilled to receive four securing screws. The two upper ones are screwed into the inner side of the firing bracket and the two lower to the left side of the cradle casing.

Later pattern caps differ from the original in being of welded construction.

THE RECOIL SYSTEM

(Plate 4)

The recoil system comprises a hydraulic buffer to regulate recoil with a hydro-pneumatic recuperator to return the gun to the run-out position and retain it there. The necessary gear is contained in a cylinder block carried under the gun within the cradle. The cylinder block is attached to the gun and recoils with it, the piston rods being secured to the cradle cap remain stationary.

The buffer is of the controlled and graduated pressure type, having a cut-off gear and rotating valve; the recuperator has a controlled run-out.

The recuperator is of the hydro-pneumatic type and comprises one liquid cylinder in which operates a piston, and one H.P. cylinder in which operates a floating piston. A retarding valve is fitted in the liquid cylinder and the two cylinders are connected at the front. The liquid and air in the H.P. cylinder are separated by the floating piston.

The buffer has no external gravity tank, but a longitudinal boring in the cylinder block performs the same function.

The **cylinder block** (Fig. 23), of steel, has four longitudinal cylinders bored in it throughout its length, that on the right being the buffer, that in the centre the H.P. cylinder, and that on the left the liquid cylinder, whilst midway between the centre and right-hand cylinders and slightly above, as viewed from the rear, is a boring which acts as a reservoir.

The block is rectangular in section, each corner having attached to it a gunmetal liner to reduce friction, the liners being secured by countersunk screws. Each liner is provided with horizontal and vertical oil grooves to distribute the lubricant.

About the centre and at the rear end, vertical projections are formed and shaped semicircular to carry the gun. The centre projection is bored vertically and screw-threaded to receive two screws which retain a semicircular strap which passes over the gun, so securing it to the block, the screws being secured by split pins.

The rear projection is formed with four semicircular parallel grooves in which engage collars formed on the exterior of the jacket so preventing longitudinal movement of the gun.

In later pattern cylinder blocks the front groove in the rear projection is filled in, or formed solid, as it is not now used due to the gun being positioned further back in the cradle.

To prevent rotational movement of the gun in the cradle, the rear projection on the cradle and the collars on the jacket of the gun are formed with a longitudinal groove, on each side, through which passes a cotter, the cotter being retained by a screw and split pin in the rear projection.

Blocks of later design differ from the original in that the front and rear gun bearings, together with the guide portion, are of a simplified design and are secured to the block by means of screwed rivets, and do not form part of the main forging. An alternative design cylinder block differs from the original forged block in being of welded construction.

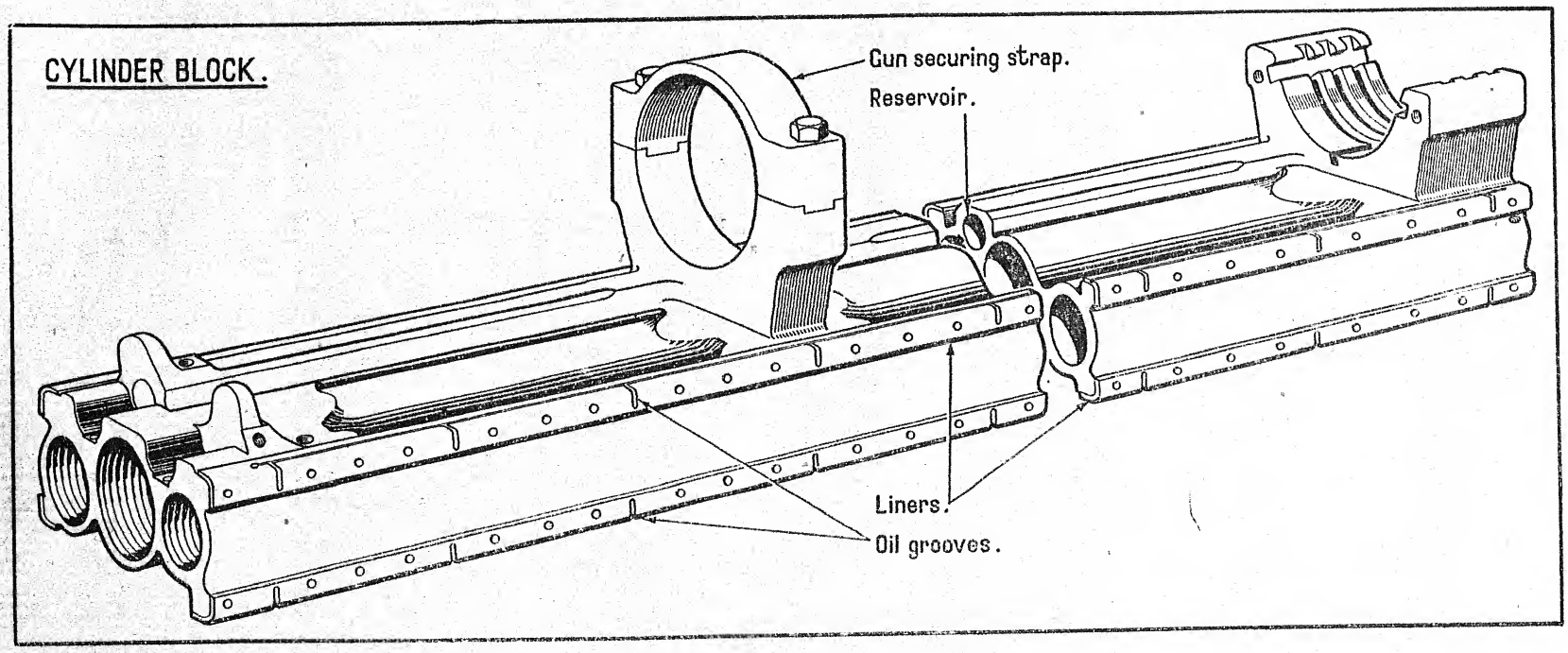
CYLINDER BLOCK.
Gun securing strap.
Reservoir.
Liners.
Oil grooves.

Fig. 23

The upper surface of the block has two longitudinal ribs, terminating in small vertical projections; to the left-hand one is secured a recoil indicator striker by two screws. The striker operates the slider of the recoil indicator. This projection has a hole, bored obliquely in its side, which leads to the H.P. cylinder, the hole being screw-threaded to take an overflow plug, which is lettered N, the engraving being filled in with red wax. (Fig. 36.)

In later pattern recuperator blocks another screw-threaded hole approximately two inches in rear of the projection containing plug N, is prepared in the block, leading to the liquid cylinder and closed by an additional N plug.

Just in rear of the right-hand projection are two vertical holes, one leading to the cylinder which forms the reservoir, whilst the other leads to the buffer cylinder, both being screw-threaded, the latter to take a snifting valve and the former for an oil adapter plug. The plug is lettered M and the engraving is filled in with red wax. (Fig. 36.)

On the upper surface, at the extreme front end, are two small recesses, one on the right and one on the left, to receive the locking arm supporting brackets, each bracket being provided with a torsion spring, and secured by two screws.

The **buffer cylinder,** has four spiral grooves cut in the interior surface throughout its effective length, in which the feathers on the rotating valve fit and operate.

The front end of the cylinder is prepared to receive a stuffing box through which the piston rod passes, whilst the rear end is prepared to receive the control cylinder.

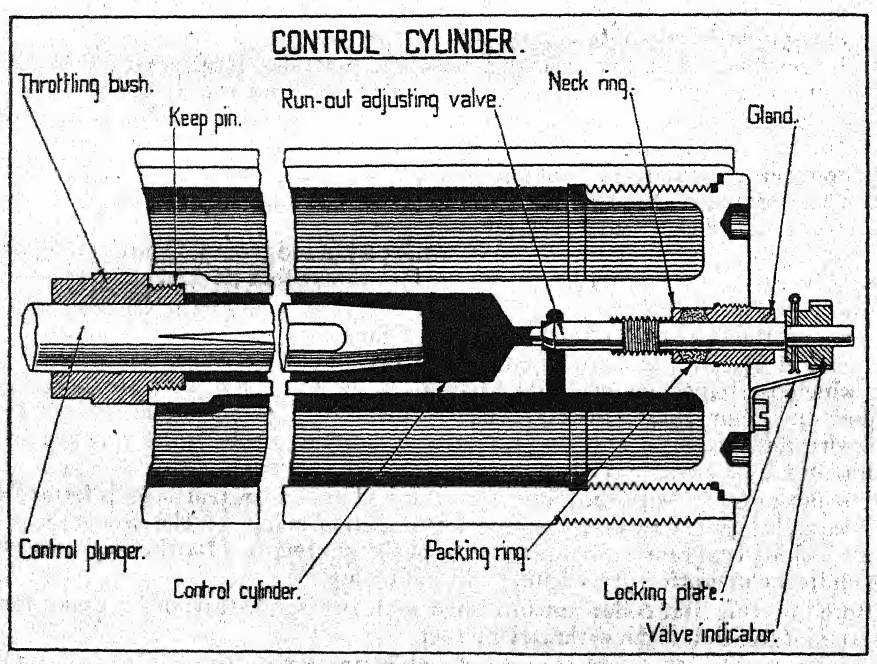

FIG. 24

The **control cylinder** (Fig. 24) closes the rear end of the buffer cylinder and is in the form of a hollow rod which has an enlarged cap at one end, the cap being screw-threaded externally to fit similar threads in the rear of the buffer cylinder. It is bored longitudinally for about three-quarters of its length to form a control chamber, and for the remaining distance with a small boring to receive the run-out adjusting valve. The front of the control chamber is screw-threaded internally to receive a rolled bronze throttling bush which is sweated in position. The function of the bush is to throttle the flow of liquid and to prevent damage to the end of the control plunger. The smaller diameter boring at the rear of the cylinder is

screw-threaded at the rear to receive a gland, and midway between the rear end of the control chamber and the rear of the cylinder is another screw thread to receive the run-out adjusting valve.

The **run-out adjusting valve** (Fig. 24) is a short spindle which is coned at one end and formed square at the other to receive the valve indicator, whilst about its centre is a screw thread to fit the cylinder.

The original coned end continued to a point, but it now has a spigoted end.

To prevent liquid leakage the valve is packed with round greased packing, the packing being retained between a rolled bronze neck ring and a gland. The rear end of the squared portion of the valve is engraved with the letter R.

Fitting over the squared end of the valve is an indicator which is secured by a keep pin. The indicator is in the form of a flanged nut having eight equally spaced serrations in which engages the end of an indicator locking plate. The rear face of the indicator has a number engraved opposite each serration from 0 to 7 respectively, all engravings being filled in with red wax.

The locking plate is of spring steel secured to the rear face of the cylinder by two screws; in addition to retaining the indicator in one position it allows of easy manipulation in the event of adjustment being necessary.

The valve controls the last few inches of run-out by varying the size of the flow space between the small passage in the rear end of the control cylinder and a small axial boring leading to the interior of the cylinder.

The numbers on the rear end of the indicator enables personnel to readily check and adjust the valve when required.

In front of the screw threads at the rear of the control cylinder is a small horizontal boring which communicates with the cylinder which forms the reservoir.

The **stuffing box** is cylindrical and formed internally with a flange at one end to form a seating for a **U**-leather supporting collar, whilst at the other end a screw thread is cut to receive a gland. The flange is drilled with six equally spaced holes to allow oil to pass through. A screw thread is cut on the exterior to suit the screw thread in the front end of the buffer cylinder.

Placed within the stuffing box and over the piston rod is a rolled bronze supporting collar which is semicircular in section to fit into the leather packing.

The collar is drilled with six T-shaped holes to allow the oil to pass through and expand the skirt of the leather packing against the walls of the cylinder. Over the collar is placed a U-leather packing on the outside of which is a rolled bronze ring which is shaped on one side to support the U-leather, and on the other to support the compressed packing. The compressed packing is made up of hemp, lead wire and graphite and pressed into shape, the whole being retained in the stuffing box by a collar and screwed gland of rolled bronze.

The periphery of both the gland and stuffing box, on the rear face, is formed with eight equally spaced recesses, those of the glands being for the reception of the glands locking arm or a wrench and those of the stuffing box for the reception of the wrench in the operation of loosening and tightening.

Both the ring and collar are furnished with two screw-threaded recesses for the insertion of the end of the withdrawing tool.

The stuffing box forms the means of preventing the escape of oil over the piston rod by the gland expanding the compressed packing radially around the internal surface of the cylinder and around the piston rod itself. The object of the U-leather is to form additional sealing effect which varies with the pressure inside the buffer. As the pressure rises, during recoil, the oil is forced through the holes in the flange of the stuffing box and the U-section packing ring, expanding the U-leather against the walls of the piston. When the pressure is maximum the sealing effect is maximum.

In later pattern stuffing boxes, the rolled bronze ring is replaced by a ring formed integral with the stuffing box, the inner end of the box being bored and screw-threaded to receive a screwed ring.

The **buffer piston rod and control plunger** (Fig. 26), of steel, are in one forging. The front portion forms the piston rod, whilst the rear portion is of smaller diameter ; the extreme end is tapered and forms the control plunger, whilst a taper flat is cut on the plunger. The diameter at the front end of the plunger is increased, whilst the rear end of this increased diameter is screw-threaded to receive the securing nut of the sliding and rotating valves. Across these screw threads are cut two featherways, diametrically opposite, to receive the feathers on the thrust ring. The

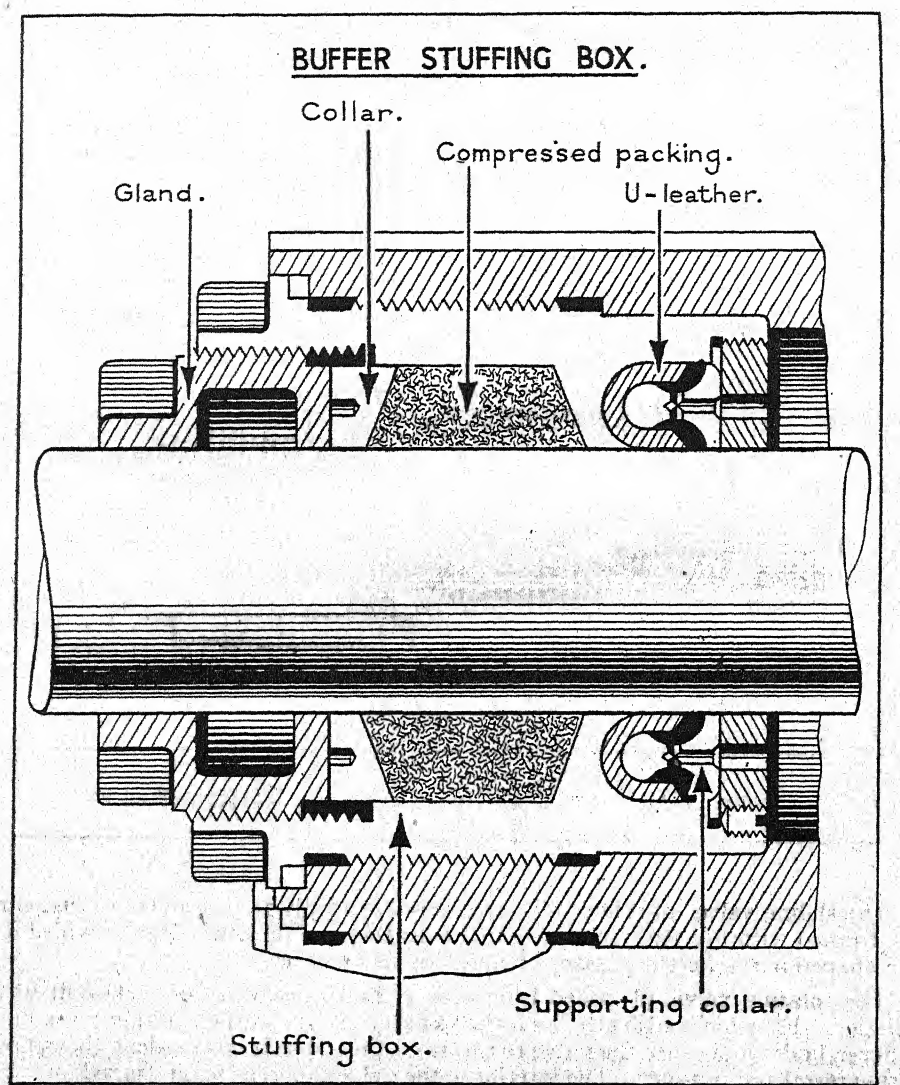

FIG. 25

diameter is still further increased in front of these screw threads, thus forming a shoulder. In rear of this shoulder are formed two longitudinal feathers, diametrically opposite. Over these feathers is placed a sliding valve in the interior of which are cut two featherways. The interior of the valve is recessed to pass over the shoulder on the rod, previously mentioned. A rotating valve is placed in the rear of the sliding valve, its forward movement being arrested by the feathers on the rod and

retained in that position by a securing nut. The securing nut is cylindrical and screw-threaded internally to fit the threads on the piston rod and machined externally to fit into a recess in the rotating valve. A hole is bored axially through the rear end of the nut and rod, through which passes a split pin. Interposed between the securing nut and the rod is a thrust ring having two feathers to engage the featherways on the rod, and two anti-friction washers to prevent seizure of the securing nut against the valve.

The front portion of the rod, where it projects from the buffer, is slightly reduced in diameter and provided with two feathers to take the bevel wheel segment of the cut-off gear. The portion of the rod that projects from the cradle cap has a coarse thread to take the piston rod nut, a hole being bored through the nut and rod to take a split pin.

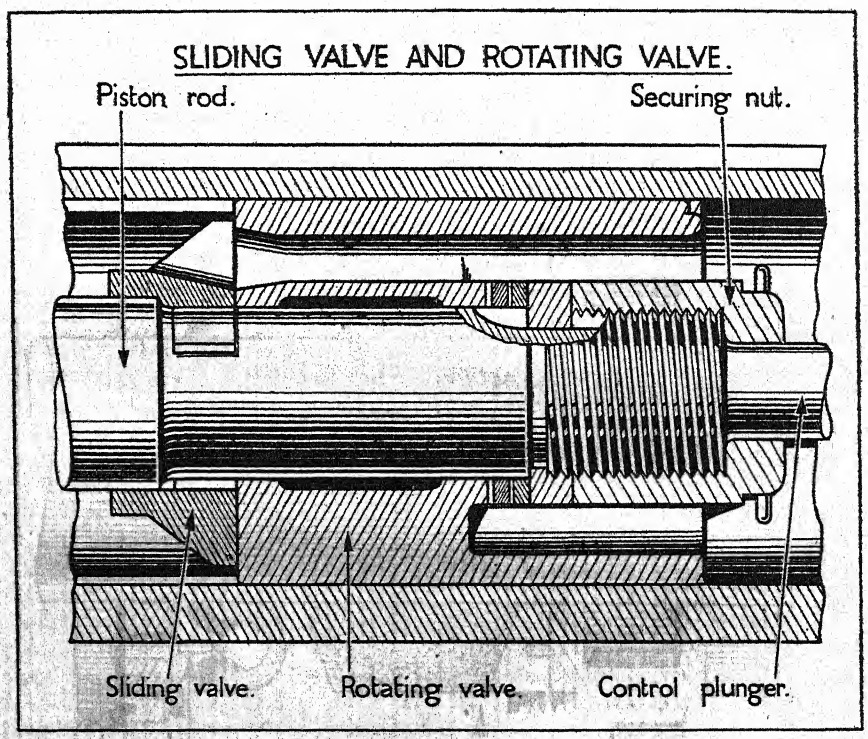

FIG. 26

The **sliding valve,** of rolled bronze, is bored centrally to pass over the piston rod and formed with two featherways to fit the feathers on the rod. It is provided with four shaped ports, for the passage of liquid, on its exterior.

The **rotating valve,** of rolled bronze, is cylindrical and a fairly close fit in the cylinder. Four inclined feathers on the exterior engage in the spiral grooves in the buffer cylinder and cause the valve to rotate on the rod as it moves along the cylinder during recoil and run-out. The interior of the valve is bored to suit the rod, on which it rotates easily, and four plain ports are cut through the body of the valve for the passage of liquid. These ports are of slightly larger angular dimensions than those of the sliding valve. A small countersunk radial hole leading from the outer surface of the valve to each port prevents any accumulation of pressure between the valve and the cylinder wall. The rear part of the valve is hollowed for about half its length to fit over the securing nut.

Both the sliding and rotating valves are retained on the rod by the securing nut which is prevented from unscrewing by a split pin.

A thrust ring and two anti-friction washers are fitted to the buffer piston to prevent excess longitudinal movement of the rotating valve.

The **reservoir** or tank (Fig. 23) is a longitudinal boring through the block which is closed at each end by a plug which is screwed and sweated in position. Communication between the reservoir and buffer cylinder is by a small vertical passage in the block towards the rear end. At the front end is a vertical boring which is screw-threaded for the reception of an oil adapter plug M.

The lower end of the plug is formed with a flat projection on which is engraved three lines, the upper one being engraved $\frac{3}{4}$, the centre one $\frac{1}{2}$, and the lower $\frac{1}{4}$. These markings are intended to be used to show the amount of liquid in the reservoir, therefore, the plug is also a dipstick.

The quantity of oil required to fill the buffer cylinder and reservoir is approximately 15 pints.

The **snifting valve** (Fig. 27) is provided to allow of the ready escape of surplus liquid or accumulated air, which might otherwise prevent the gun returning fully to the run-out position and consists of a guide, seating, collar and valve.

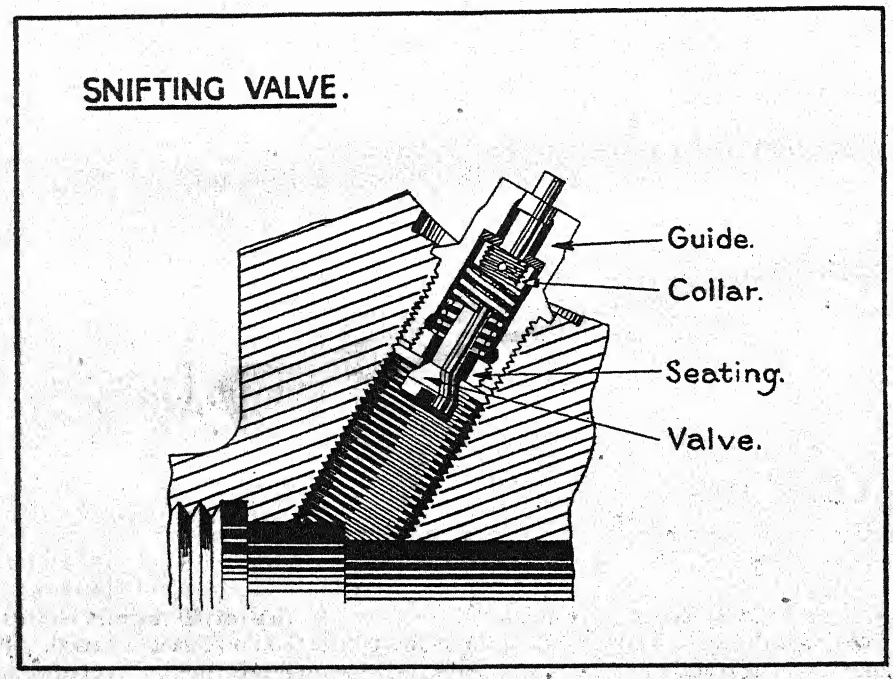

FIG. 27

The guide is formed square at one end for the application of a spanner, whilst at the other end it is screw-threaded to screw into the hole at the front end of the buffer cylinder. It is bored internally in two diameters, that at the top being for the reception of the valve spindle, whilst that at the lower end is for the collar and spring. The extreme lower end is screw-threaded to take the seating. Around the interior surface of the upper boring are cut four longitudinal grooves for the passage of air or liquid.

The seating is a small flanged collar, screw-threaded externally to screw into the lower end of the guide. Internally, near the centre, is formed a flange to act as a seating for the valve.

The collar is a small screw-threaded washer around the periphery of which are cut six equally spaced longitudinal grooves whilst a hole is bored axially through

the collar and valve spindle through which passes a split pin to secure the collar on the spindle.

The valve is a countersunk-headed spindle which is screw-threaded in the centre to receive the collar, whilst the upper end is slightly enlarged to fit the boring at the upper end of the guide. Between the collar and the upper end of the seating is placed a spiral spring, therefore, when in position in the cylinder block, slight digital pressure on the upper end of the valve spindle will compress the spring between the collar and seating, taking the countersunk head of the valve away from the seating, leaving a passage between the valve and its seating through the grooves in the collar and out between the top of the spindle and the guide.

The new pattern snifting valve differs principally from the previous pattern in being of a spring loaded ball type in place of a cone spindled valve, the old pattern being obsolescent.

The **cut-off gear** (Fig. 28) is fitted to the right side of the cradle. Its function is to automatically control the length of recoil, so as to prevent the recoiling portions touching the trail or ground, thereby damaging the equipment.

The length of the recoil depends upon two main factors, the energy of recoil and the size of the flow space past the sliding and rotating valves in the buffer. Assuming the recoil energy to remain constant, the length of recoil can be varied by altering the size of the orifice or flow space past the sliding valve and this is put into effect by the cut-off gear. The normal setting of the gear places the sliding and rotating valves, before firing, in such a position relatively that the rotating valve must travel 40 inches to close the flow space completely with the gun at zero on the elevation scale. The cut-off gear working automatically as the gun is elevated, causes the sliding valve

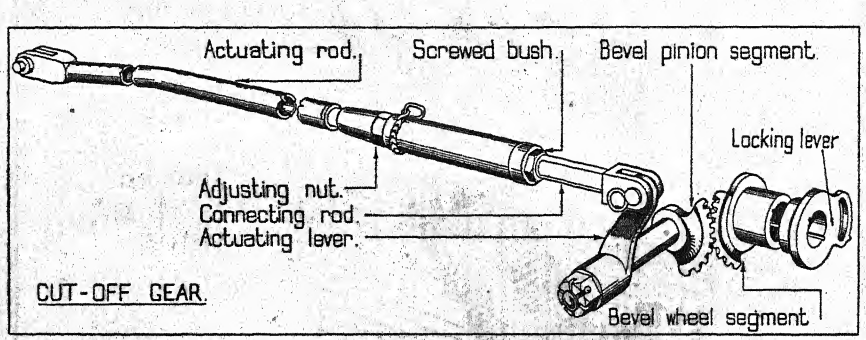

Fig. 28

ports to move away from the rotating valve ports, so that at 40 degrees elevation the rotating valve has to travel only 16·5 inches before the flow space is closed. The distance to the closing of the ports for intermediate angles is roughly proportionate to these two.

It must be observed that the mechanical closing of the ports of the sliding and rotating valve fixes the theoretical maximum recoil lengths only. With the valves in good fitting condition, closing of ports should mean the termination of recoil, but in practice it is found that the recoil continues some distance beyond the point where the ports are completely closed. The amount of overrun varies with the angle on the quadrant scale, being greatest at the highest angles, so that the *nominal* recoil, as distinct from the *theoretical* recoil, may range from 36 inches at zero to 20 inches at 40 degrees. The angles quoted against recoil lengths do not refer to angles of elevation, but to the relative position of trail and cradle as indicated on the quadrant scale below the sight gear.

The gear consists principally of the following parts :—

Bevel wheel segment, bevel pinion segment, connecting link, actuating rod and locking lever.

The **bevel wheel segment,** of steel, is bored internally and formed with two featherways to engage the feathers on the buffer piston rod. A flange on the segment, which contains nine teeth, engages similar teeth on a bevel pinion; the two teeth at one end of the segment are placed wider apart than the remainder to engage a large tooth on the bevel pinion.

The **bevel pinion segment,** of steel, is a short spindle with featherways formed at one end to engage a connecting link actuating lever. This end is also screw-threaded for the reception of a slotted nut and keep pin to retain the lever on the spindle; in addition, the slotted nut secures the segment in the front cap. The other end of the segment has a flange with nine teeth, the end one of which is larger than the remainder to engage with the two teeth which are wider apart on the bevel wheel segment; this ensures correct assembly. In rear of the flange is a machined surface to engage the bronze bush in the front cap.

The **connecting link** comprises an actuating lever, connecting rod, screwed bush and adjusting nut.

The actuating lever has a boss at its lower end which is bored internally and prepared with feathers to engage the featherways on the bevel pinion segment. The upper end of the lever is also bored to engage the forked end of the connecting rod.

The connecting rod is flattened in the centre, with a fork formed at one end to engage the actuating lever; the fork is bored axially, one projection being screw-threaded to receive the lever pin, whilst the other end of the rod is screw-threaded to receive the connecting nut. Between the flattened portion and the screw thread is a flange, and below this a machined portion to pass through the centre of the screwed bush, the rod being retained in the bush by the nut screwing over the screw-threaded portion and retained by a split pin. This method of assembly allows rotary movement of the rod in the screwed bush.

The lever pin is flanged, with a loop at one end and a screw thread at the other to engage the threaded projection on the fork.

The screwed bush is cylindrical and screw-threaded externally at one end to engage with the screw threads in the interior of the adjusting nut to which it is secured against rotation by a split pin passing through the periphery of the threads, thereby making the bush and nut one unit.

The adjusting nut, of steel, is an elongated cylinder, formed hexagonal externally at one end and terminating in a taper, and engraved with a small arrow to act as a reader for the adjusting screw. In front of the hexagon an elongated slot is cut through the nut to take a cotter pin which secures the adjusting nut to the adjusting screw, whilst above the slot is engraved an arrow and the words TO SHORTEN. Engraved on the nut are the words ONE TURN SHORTENS RECOIL ·65 INCH, all engravings being filled in with red wax.

The nut has internal screw threads at one end, to engage similar threads on the screwed bush, a hole being bored axially through the threads to take a split pin, whilst the other end is formed internally with screw threads to take those of the adjusting screw.

The **actuating rod** comprises a rod, forked end and adjusting screw.

The rod is a steel tube bent towards the cradle and screw-threaded at one end to receive the forked end and at the other to receive the actuating adjusting screw, each part being secured by a taper pin.

The forked end engages with the rear end of the actuating rod where it is retained by a taper pin. The other end is formed with two lugs to engage with the lug on the right trunnion bracket. The lugs are bored to receive a connecting pin which is retained by a washer and keep pin.

The adjusting screw has a flange and screw threads at one end, the screw threads engaging in the front end of the actuating rod, where it is retained by a taper pin, whilst the flange forms a stop to prevent the threads passing too far into the rod. The other end of the screw is screw-threaded to receive the connecting link adjusting nut. To prevent the nut from rotating until desired, the screw threads are slotted

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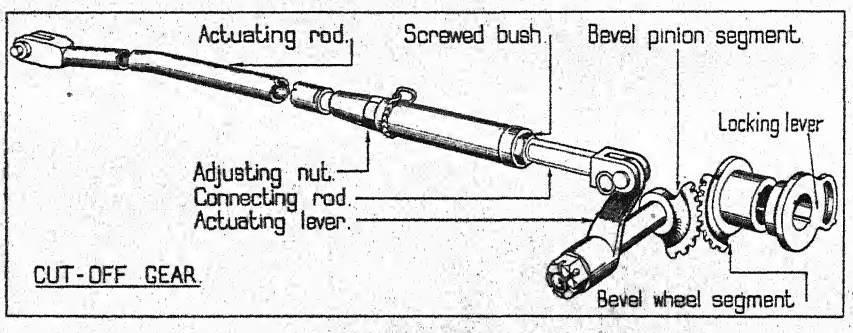

FIG. 28

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The **connecting link** comprises an actuating lever, connecting rod, screwed bush and adjusting nut.

The actuating lever has a boss at its lower end which is bored internally and prepared with feathers to engage the featherways on the bevel pinion segment. The upper end of the lever is also bored to engage the forked end of the connecting rod.

The connecting rod is flattened in the centre, with a fork formed at one end to engage the actuating lever; the fork is bored axially, one projection being screw-threaded to receive the lever pin, whilst the other end of the rod is screw-threaded to receive the connecting nut. Between the flattened portion and the screw thread is a flange, and below this a machined portion to pass through the centre of the screwed bush, the rod being retained in the bush by the nut screwing over the screw-threaded portion and retained by a split pin. This method of assembly allows rotary movement of the rod in the screwed bush.

The lever pin is flanged, with a loop at one end and a screw thread at the other to engage the threaded projection on the fork.

The screwed bush is cylindrical and screw-threaded externally at one end to engage with the screw threads in the interior of the adjusting nut to which it is secured against rotation by a split pin passing through the periphery of the threads, thereby making the bush and nut one unit.

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The **actuating rod** comprises a rod, forked end and adjusting screw.

The rod is a steel tube bent towards the cradle and screw-threaded at one end to receive the forked end and at the other to receive the actuating adjusting screw, each part being secured by a taper pin.

The forked end engages with the rear end of the actuating rod where it is retained by a taper pin. The other end is formed with two lugs to engage with the lug on the right trunnion bracket. The lugs are bored to receive a connecting pin which is retained by a washer and keep pin.

The adjusting screw has a flange and screw threads at one end, the screw threads engaging in the front end of the actuating rod, where it is retained by a taper pin, whilst the flange forms a stop to prevent the threads passing too far into the rod. The other end of the screw is screw-threaded to receive the connecting link adjusting nut. To prevent the nut from rotating until desired, the screw threads are slotted

for about half their length, to receive a cotter pin. Midway between the flange and the screw thread is a machined portion which is engraved with a horizontal line and eight short and one long vertical lines intersecting it. The long line in the centre is engraved 0, whilst on either side are four short lines representing two, the 4 and 8 being numbered, all engravings being filled in with red wax.

The **locking lever,** of steel, is a circular boss, bored centrally and formed with featherways to engage the feathers of the buffer piston rod. It has a flanged projection in which a semicircular slot is cut to engage with a stud on the front cap. The nut of the stud retains the locking lever in the required position. To indicate this position a small projection is formed on the periphery of the flange on which is engraved an arrow which reads in conjunction with the recoil indicator secured to the front cap, the arrow being filled in with black wax.

The locking lever passes over the buffer piston rod from the exterior of the front cap and is secured by the nut of the stud and the securing nut of the piston rod.

The cotter pin secures the adjusting nut and is furnished with a small brass chain which is secured by one end link to the looped head of the pin. The other end of the chain has a small spring S-hook which hooks into a slot in the lower end of the pin, so securing the pin against accidental removal.

Action of the cut-off gear

Owing to the pivot of the actuating rod being displaced from the axis of the cradle trunnion, the operation of elevating and depressing the gun causes the rod to pull, or push, upon the actuating lever, rotating the bevel segments, piston rod and sliding valve of the buffer, thereby altering the flow space past the ports in the sliding valve and rotating valve. The rotating valve does not move during the operation of elevating or depressing, being held by its feathers in the grooves of the buffer cylinder.

The sliding valve ports thus move away from those of the rotating valve, reducing the initial flow space and leaving the valve a shorter distance to travel before the ports are closed and recoil terminated.

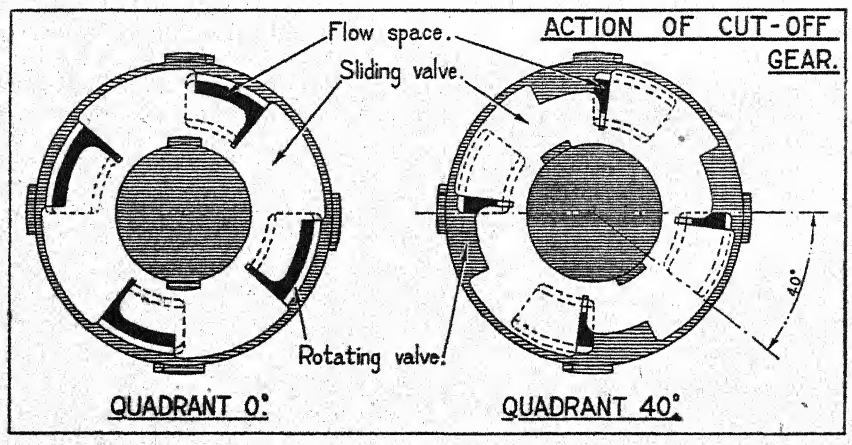


FIG. 29

(The above figure does not depict the correct direction of sliding valve rotation with this equipment, but it does illustrate the manner in which the flow space is varied by operating the elevating gear of the carriage.)

Depressing the gun has the opposite effect. The action of the cut-off gear is dependent upon the elevating gear and ceases when the elevation has been applied.

The **recuperator** comprises two cylinders, lying side by side, the one on the left, looking from the breech, is known as the liquid cylinder, the other as the H.P. cylinder. Although contained in the same cylinder block as the buffer, there is no

communication between the buffer and recuperator systems; they co-operate as a recoil system, but operate quite independently. The liquid cylinder has a packed head with piston rod, the space in front of the head being completely filled with liquid. The front part is connected, by means of a radial channel, to the front part of the H.P. cylinder. The H.P. cylinder contains liquid in the front portion and air in the rear portion, the two elements being separated by a floating piston suitably packed to prevent intermixing of the air and liquid.

The air is maintained under an initial pressure of 600 lb. per square inch, thus, on recoil, the piston sweeps the liquid from the liquid cylinder into the H.P. cylinder,

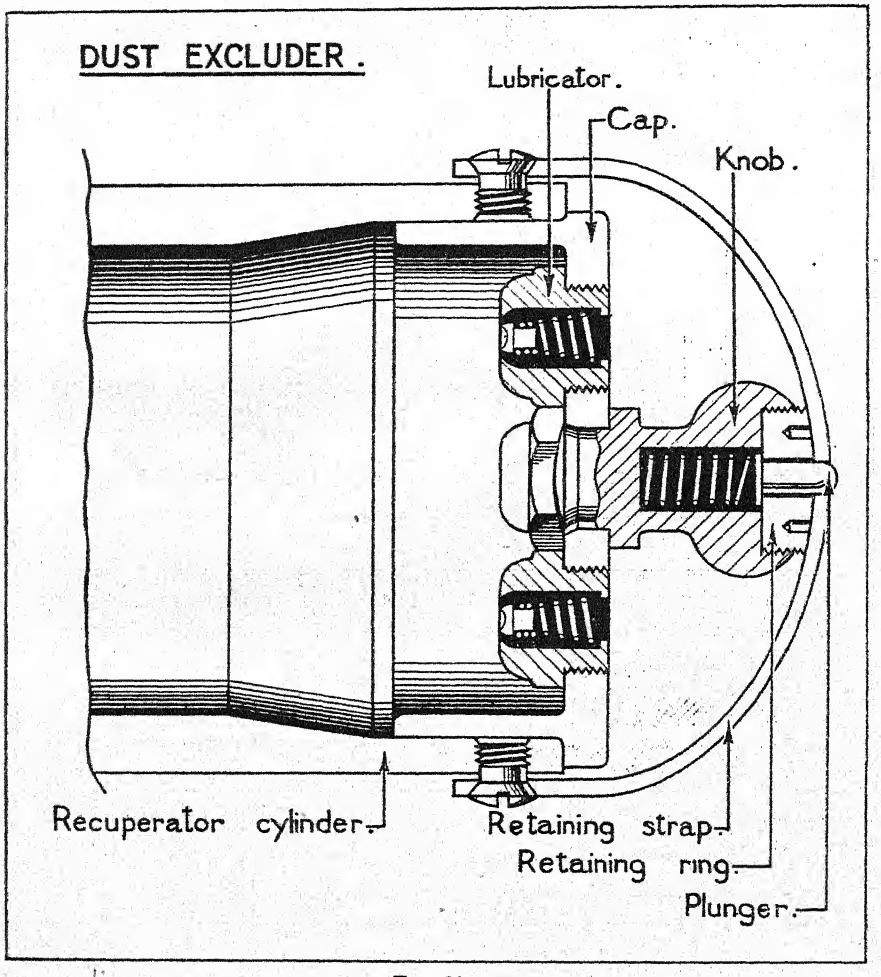


FIG. 30

forcing the floating piston to the rear, still further compressing the air. On recoil ceasing, the reaction of the air pushes the floating piston forward, expelling the surplus liquid from the H.P. cylinder into the liquid cylinder, carrying the gun forward into the run-out position.

The **liquid cylinder** consists principally of a cylinder, dust excluder, retarding valve, piston rod, piston head packing, locking plunger, piston rod packing and safety collar.

The **cylinder** is bored out of the cylinder block, tapered internally for a short distance at the rear to facilitate the assembly of the packed piston and prepared at

the rear end to receive the dust excluder. The front part of the cylinder is prepared to receive the stuffing box and packings, in rear of which a shoulder is formed against which fits a seating for the retarding valve. Between the stuffing box and the shoulder an opening or communicating channel is bored in the side into the H.P. cylinder.

The **dust excluder** (Fig. 30) comprises cap, knob, plunger and ring, all of rolled bronze and retained by a strap.

The cap is cup-shaped, having a flange at the rear and machined externally to make a tight fit in the rear end of the recuperator cylinder. On the periphery of the flange a small projection is formed which engages with a projection on the rear end of the cylinder to position the cap. The rear end is bored and screw-threaded for the reception of four top oiler lubricators (the lubricators are not provided for

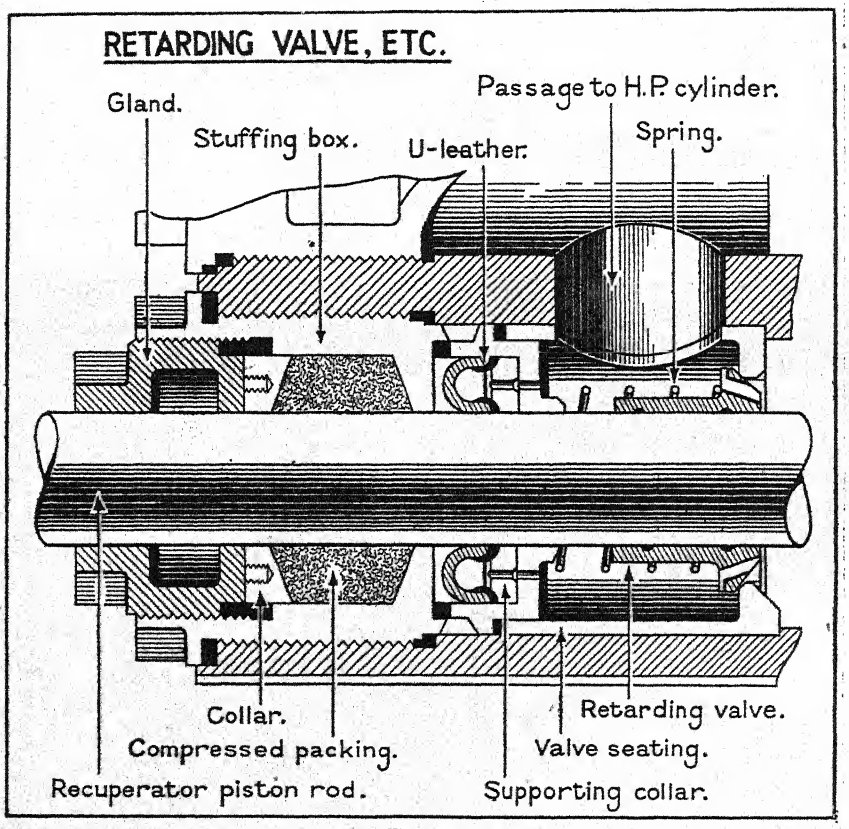


FIG. 31

lubrication purposes but to allow for the passage of air) and in the centre for a knob.

The knob is retained by riveting and is recessed for a spring and screw-threaded for a retaining ring. Passing through a central boring in the ring is the plunger, which has a flange at one end and is rounded at the other to fit into the hole in the strap.

The strap, of steel, is semicircular in shape and retains the dust excluder in position in the end of the cylinder by having a hole bored in it through which passes the plunger. A hole is drilled in each end of the strap for the reception of the screws which secure it to the exterior of the cylinder block.

By pressing in the plunger against its spring the former is disengaged from the strap, which then hinges on its securing screws, so releasing the dust excluder.

The **retarding valve** (Fig. 31), of bronze, with its seating and spring, fits into the front end of the recuperator cylinder ; the seating fits up against the shoulder and is retained by the stuffing box. The regarding valve and spring fits and slides on the recuperator piston rod, the spring taking a bearing between a shoulder on the valve and a projection on the stuffing box. The valve lies between the interior of the stuffing box and the valve seating and is coned to fit the seating, having four holes drilled through the head to permit the passage of liquid when the valve is closed ; two circumferential oil grooves are provided in its interior. The valve opens during recoil and is closed by the spring immediately recoil has terminated ; when open, the flow space around the valve is considerable ; when closed, the flow space is confined to four small holes.

The **piston rod** is of steel, the rear part being formed with a flange which performs the function of a supporting ring, one side being shaped for the U-section packing and the other for the compressed packing. In front of the flange the rod is screw-threaded to receive the front packing supporting nut which is secured by a split pin, whilst the extreme rear end is recessed and screw-threaded internally for the locking plunger and its rolled bronze bush. Externally the rear end is screw-threaded to receive the rear packing supporting nut.

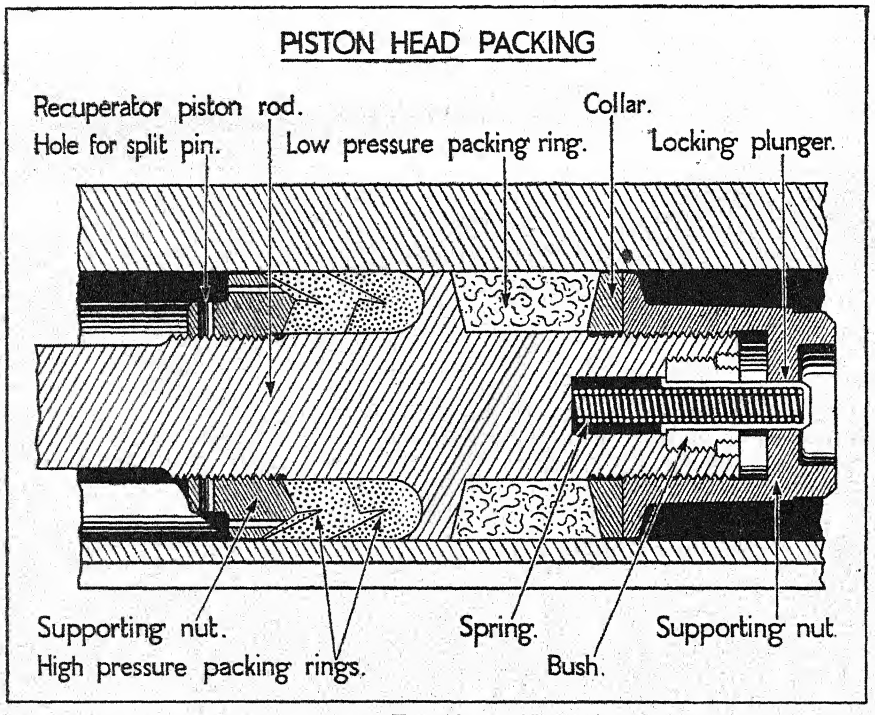


FIG. 32

The front end of the rod is slightly reduced in diameter and formed with two wide feathers, diametrically opposite each other, for the reception of the safety collar, whilst just in front is formed a feather to engage in a featherway in the front cap.

The extreme front end is formed with coarse threads to receive the front nut. The safety collar is formed with a small projection and is bored for a split pin which passes through the collar and piston rod. The collar is engraved with the words NOT TO BE REMOVED UNTIL PRESSURE HAS BEEN RELEASED, the engraving being filled in with red wax. The front nut is slotted and is retained on the rod by a split pin passing through an axial hole drilled in the front end of the rod.

The **piston head packing** (Fig. 32) consists of a high pressure and low pressure packing which is separated and supported by the flange formed on the rod. The high pressure packing is on the front side of the flange and consists of two No. 6 or No. 10 U-section packing rings which are secured on the rod by the front packing supporting nut. The front packing supporting nut is a hexagonal flanged steel nut having a hole bored in each face of the hexagon for a split pin, whilst six small holes are bored through the flange to allow the oil under pressure to pass through to the U-section packing.

The low pressure packing is assembled on the rear side of the flange on the rod and consists of a ring of hemp, lead wire and graphite compressed packing which is supported by a collar, secured, and placed under compression by the rear packing supporting nut. The rear nut is recessed internally and screw-threaded to pass over the screw threads on the end of the piston rod and secured against rotation by a locking plunger.

The locking plunger is square in section and retained in the recess in the end of the rod by a screwed bush and kept up to its work by a spiral spring. The rear end of the rear packing supporting nut is formed with a square hole into which fits the plunger. The application of the wrench to the hexagon nut disengages the plunger from the nut ; it may then be rotated for tightening or removal purposes. Removal of the wrench allows the spring to force the plunger into the hole in the nut, so locking it.

The piston rod packing (Fig. 31) consists of a gland, packing and supporting rings contained in a steel stuffing box. The U-leather ring is a No. 2 U-section packing ring, all other components being similar to those described for the buffer piston, but smaller in diameter.

The **H.P. cylinder** consists principally of a cylinder, floating piston and stuffing box.

The cylinder is the central boring of the block and is closed at the rear end by a rear closing plug which is screwed and sweated in position and positioned by a grub screw. The front end of the cylinder is prepared to receive the floating piston with its packing and stuffing box whilst the interior of the cylinder is plain and highly polished.

The rear closing plug (Fig. 33) is formed with a small rectangular projection on its rear face through which are bored two holes, the upper one passing right through the plug and the lower one terminating at about 0·5 inch from the front face. Between these two borings is an axial boring connecting the two together at the front end. The upper boring is prepared for the reception of the air valve and its components, whilst the lower one is prepared to take the adapter hole plug. The adapter hole plug has a hexagonal head and screws in against a fibre washer. The rear face of the plug is engraved with a letter H, the letter being filled in with red wax. The shank of the plug has a longitudinal and circumferential groove cut in it to allow for the release of the air in the cylinder when desired, without completely removing the plug. The passage leading from this adapter hole into the cylinder is controlled by the valve.

The air valve (Fig. 33) consists of a valve, spindle, packing and gland.

The valve is a small steel spindle with a coned head at one end and a circumferential groove at the other, around which passes a piece of wire to secure it to the spindle. The point of the cone is hardened.

The spindle is formed with three longitudinal grooves at one end for the passage of air and formed square at the other for the application of a key.

The rear face is engraved with the letter K, the letter being filled in with red wax. Towards the front end screw threads are cut to engage the boring in the rear plug.

Around the spindle is wound some round grease packing, on either side of which is placed a rolled bronze neck ring. The packing is retained in position by a rolled bronze gland. Over the points of the hexagon head of the gland is placed a steel locking plate ; the plate is pear shaped and formed with twelve serrations to fit over the points of the hexagon, the plate being secured by a set screw.

The front end of the H.P. cylinder is screw-threaded to receive the stuffing box.

The floating piston (Fig. 34) consists of a packed piston and tail rod, the latter

passes out through a stuffing box and forms an indication or tell-tale of the position of the piston in the cylinder. The reader for the tell-tale is the rear edge of the slot in the floating piston rod cover, consequently, the usefulness of the tell-tale function is lost when the front cap is removed or the cylinder block not fully run out.

Neglecting the friction of the packings, the pressure in each side of the floating piston is equal. As, however, the tail rod is exposed to atmospheric pressure only, the pressure per square inch on the liquid is greater than the pressure per square inch

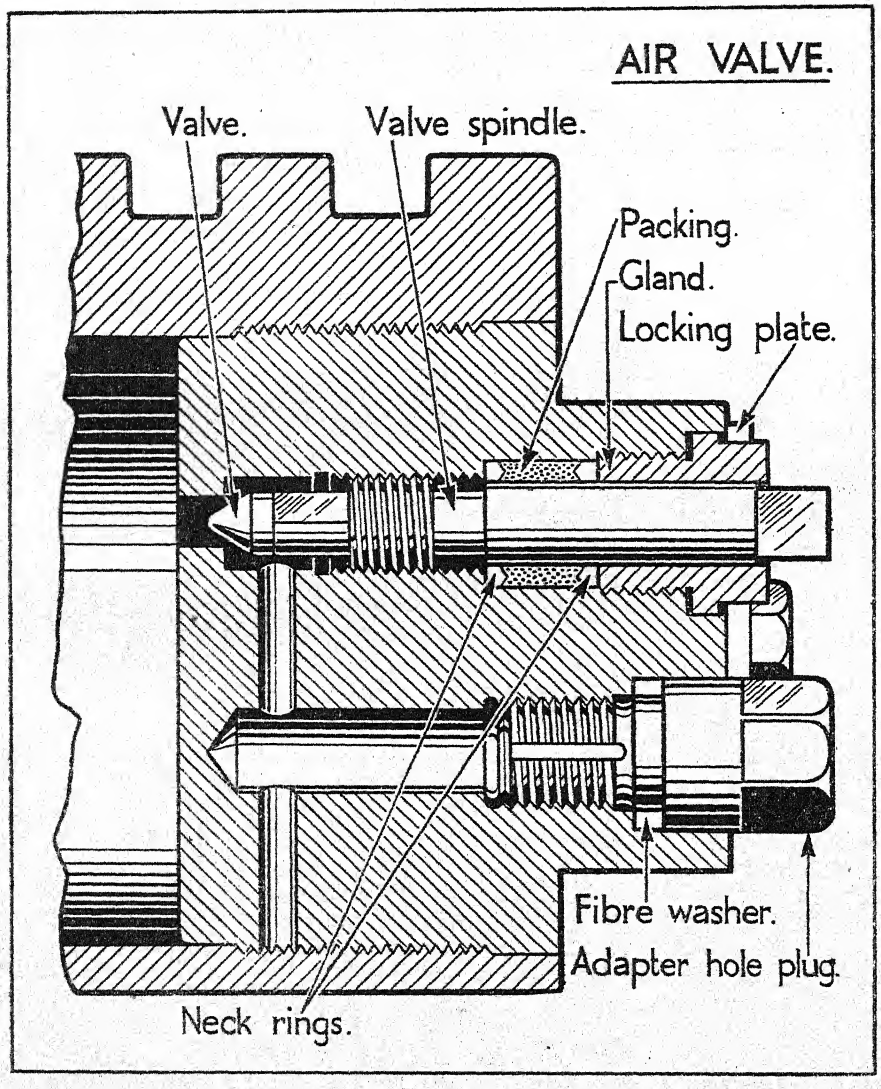


FIG. 33.

on the air, consequently, the liquid pressure is said to be intensified, and should therefore prevent the escape of air over the piston. The liquid is itself prevented from passing the piston by the action of the piston packings. Theoretically, therefore, the air and liquid should not mix; in practice, however, they often do. This intermixing may be due to faulty packings, variations in dimensions of the cylinder and piston fittings, or to the small margin of intensification being neutralized when the packings are tight. The air may pass to the liquid side, or the liquid may pass

to the air side, or again, the two escapes may be found in conjunction. For these causes it is not possible to accept the position of the tail rod as an absolutely correct indication of the state of the recuperator. Tests are given on page 90, by means of which correct conclusions can be more readily reached.

The **floating piston head,** of steel, is hollowed from the rear for the dual purpose of lightness and to increase the capacity of the reservoir. It is recessed in front to receive the rod and screw-threaded to receive a screwed ring. It is prepared on the exterior with a flange which is shaped to form a supporting ring at the front end, whilst at the rear end the exterior is screw-threaded to receive a packing securing nut.

Later design piston heads are solid instead of fabricated.

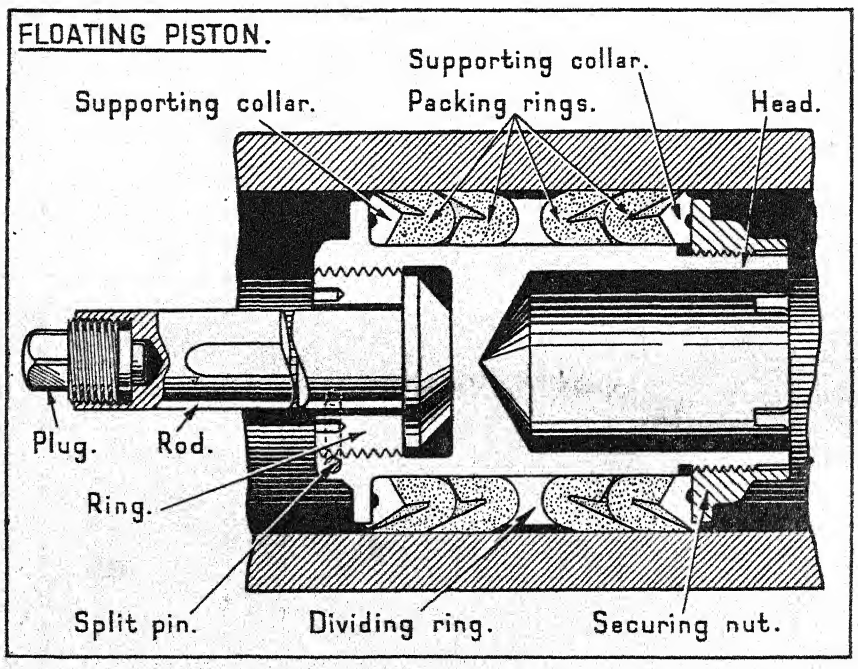


FIG. 34

The **rod,** of steel, is cylindrical and bored for the whole of its length, the front end being prepared for the reception of a non-return valve and plug. A flange is formed on the rear end where it enters the head, and coned on its rear face. The rod is secured to the head by a screwed ring; this method of attachment provides flexibility and leads to smooth working. Two axial holes are bored just in front of the flange to allow for the passage of liquid from the centre of the rod to the cylinder. These holes coincide with a deep circumferential groove which is formed in the interior of the screwed bush. Two longitudinal holes are bored through the bush from its front face to the groove, therefore oil passes along the interior of the rod, through the axial holes and into the grooves in the bush and from thence to the cylinder by the holes in the bush. The front part of the rod is formed with two flats for the application of a spanner during assembly or dismantling. The bush is retained by means of a split pin passing through the periphery of the screw threads of the screwed bush and the end of the piston head. The flange on the piston head has six small holes bored in it to allow the oil access to the packings.

A new pattern floating piston rod will be found on the latest equipments.

The rod (Fig. 34), of steel, is solid having a recess at the front end which is screw-threaded to receive a plug or a withdrawing tool. Approximately two inches from

the front end two flats are formed, diametrically opposite, for the application of a spanner to prevent the rod rotating whilst tightening up the plug or withdrawing tool. A letter L is stamped at the front end of the rod, on the upper surface, and filled in with red wax. A flanged head is welded to the rear end, where it enters the piston head and is coned on its rear face.

The rod is secured to the piston head by a securing ring; this method of attachment provides flexibility and leads to smooth working. The screwed ring is secured by means of a split pin passing through the periphery of the screw threads of the screwed ring and the end of the piston head.

The flange of the piston head has six small holes bored in it to allow the liquid access to the packings. Where this rod is fitted, the recuperator is filled through the N plug.

The **piston packing** is in two parts, front and rear. These packings are divided by a packings dividing ring of rolled bronze and formed with a semicircular groove on each side to fit the packing rings. On each side are two inverted type No. 5 or No. 9 U-section packing rings and a packing supporting collar of rolled bronze.

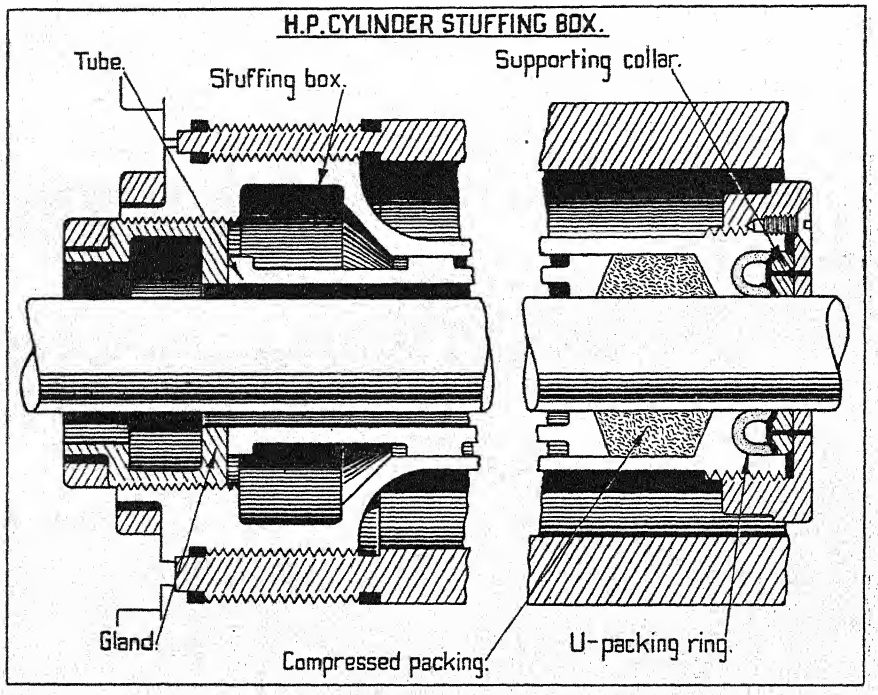


FIG. 35

The collars are provided with six small holes to allow liquid or air access to the lip of the packings and so increase the sealing effect. The lips of the packings are placed in the opposite direction on each side to facilitate this function. The whole assembly is retained on the head by the packing securing nut; the nut is a flanged slotted nut, the flange of which is bored with six small holes to allow access to the packings of the air under pressure, the nut being retained by a split pin.

The non-return valve by which the recuperator and floating piston chamber are filled with oil is contained within the front end of the floating piston rod and protected against damage by a plug.

The plug, of steel, is hollow and formed square externally for the application of a spanner and screw-threaded at the rear end for insertion into the front end of the floating piston rod. The front face of the plug is engraved with the letter L, the letter being filled in with red wax.

The valve comprises a seating, valve and ring.

The seating is cylindrical and prepared internally for the reception of the valve and its spring and ring. The valve is a small steel spindle with a coned head which is retained in the centre of the seating by the ring. Fitting over the spindle between the head and the rolled bronze ring is a spiral spring. Externally the seating has a flanged head to form a stop, whilst a screw thread is cut about its centre to fit the interior of the rod. Two slots about $\frac{1}{2}$ inch in length are bored through the seating from side to side to allow for the passage of oil. Screwdriver slots are prepared in the end of the ring and seating for the application of a tool wrench for removal and assembly.

The **stuffing box** of the floating piston is of steel and is in the form of a long box which performs the dual function of containing the packing for the rod and also forms

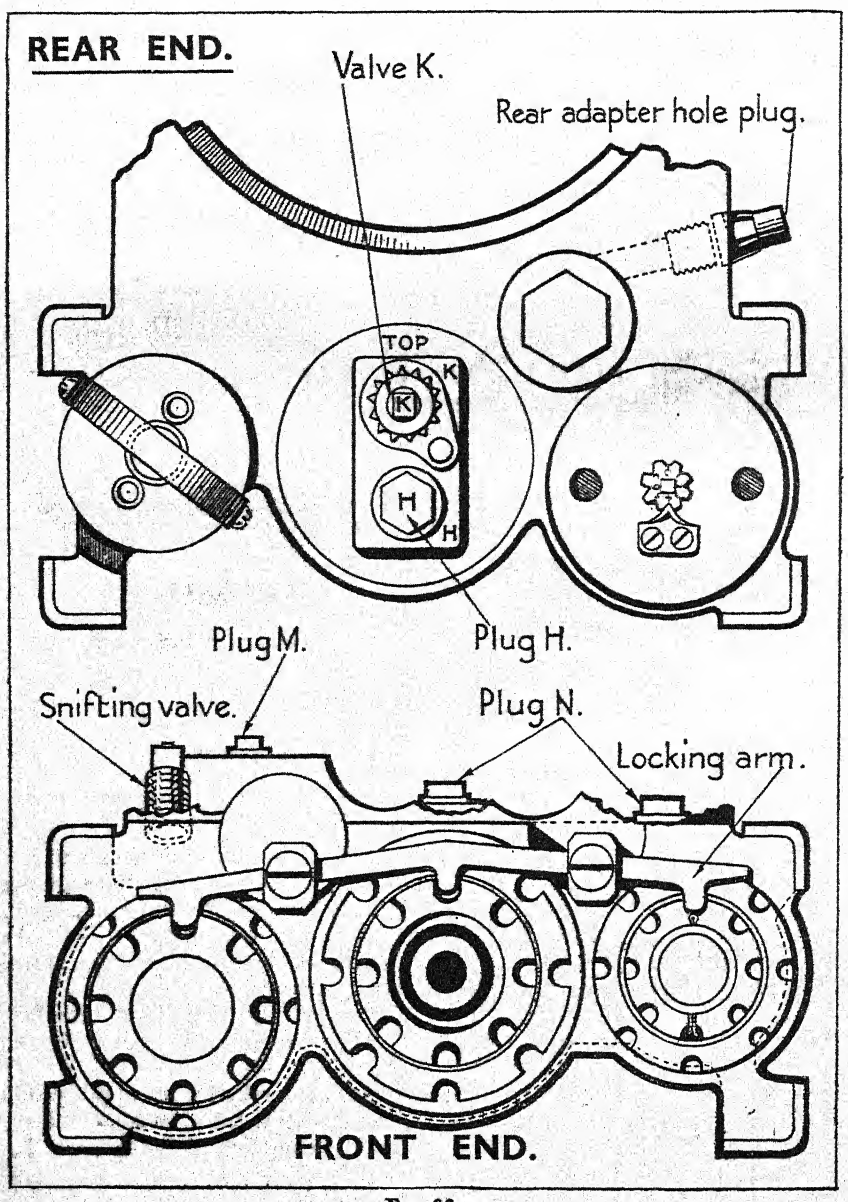


FIG. 36

a support. The front end contains the gland and the rear end the packing; to transmit the pressure of the gland to the packing, a long rolled bronze tube is interposed. The gland is of steel and formed with eight semicircular slots in which engage the projection on the locking arm.

The packing, contained within the rear end of the stuffing box, consists of a ring of compressed packing, compressed by the gland between the shaped end of the tube and a U-packing backing collar, whilst between the backing collar and a U-packing supporting collar is a No. 2 U-section packing ring. Both the U-packing supporting collar and the rear end of the stuffing box have six small holes to allow access, of the oil, to the U-packing.

In later pattern stuffing boxes (Fig. 35) the U-packing backing collar is formed integral with the stuffing box, the rear end of the box being screw-threaded externally to receive a supporting collar retaining nut. The nut is prevented from rotation by a check screw. They also differ from the original in that a flange with two locating holes is placed over part of the screwed portion, whilst the new pattern compressed packing supporting tube differs from the former pattern in having a bronze sleeve brazed into the steel outer sleeve to form a guide for the floating piston rod.

The glands of the buffer, liquid cylinder and H.P. cylinder are locked against rotation by a glands locking arm (Fig. 36).

The arm is a steel bar with five projections formed on it. Two of the projections are bored to pass over the locking arm positioning plates, where they are secured by a knurled nut and split pin, the other three projections are each provided with a spring plunger which fit into the slots formed in the periphery of the glands.

The latest pattern glands locking arm is supported on a left and right locking arm supporting bracket.

The arm is a steel bar with three projections on its under side to engage in the slots of the glands of the cylinder block to prevent them rotating, where they are retained by a torsion spring fitted to each supporting bracket. The projections are disengaged from the slots by inserting a screwdriver under the flanged ends of the arm, through a hole provided in each side of the front cradle cap.

The quantity of oil required to fill the recuperator and floating piston cylinders is approximately nine pints.

Action of buffer and recuperator

Before firing, the operation of elevating in conjunction with the cut-off gear rotates the buffer piston rod and with it the sliding valve so that the ports are in the correct position to give the most suitable length of recoil, in accordance with the reading on the quadrant scale.

On firing, the gun and recuperator block slide between the guides in the cradle, taking with it the buffer and recuperator cylinders, which are drawn over their piston head. The liquid in the buffer cylinder is forced from front to rear of the sliding and rotating valves, through the ports of the valves; at the same time the liquid in the recuperator is swept by the piston head into the H.P. cylinder, past the retarding valve, which is lifted off its seating, so pushing the floating piston further into the air cylinder, and raising the pressure. These two operations combine to absorb the recoil energy and check the movement of the gun.

During recoil, the grooves in the buffer cylinder cause the rotating valve to rotate behind the sliding valve, varying the flow space past the two valves, thus graduating the pressure within the buffer cylinder and regulating the movement of the gun.

On recoil ceasing, the retarding valve is closed by the action of its spring and the sliding valve is forced away from the rotating valve by the action of the liquid through the ports of the rotating valve. The air pressure in the cylinder forces the floating piston to the front sweeping the liquid from the H.P. cylinder into the recuperator cylinder through the holes in the retarding valve, thus carrying the gun

and recuperator block forward to the run-out position and retaining it there at all angles of elevation.

During run-out, the closing of the retarding valve restricts the flow space in the recuperator system to the four small holes in the head of the valve, with the result that the passage of liquid is retarded. As the sliding valve is clear of the rotating valve, the shape and size of the ports provide that, during the greater portion of the run-out, the flow space is large and little resistance is offered by the buffer to the passage of the oil in passing from the rear to the front of the rotating valve, therefore a rapid run-out is experienced.

As the gun nears the run-out position the control plunger enters the control chamber (which has meanwhile been filled with liquid) and displaces the liquid there, at first by way of the flat on the control plunger and the run-out adjusting valve but in the final inch or so, by the space past the adjusting valve only, so preventing the gun returning violently to the firing position.

Care and preservation

Many considerations affect the correct working of the recoil system. Broadly these may be grouped under three headings :—

1. The correct filling and charging of the system.
2. Packings.
3. The careful observation of the system both in and out of action.

1. The correct filling and charging of the system

It is most important that the system should be correctly filled and charged in accordance with the instructions laid down on pages 89 to 90. Should these operations be performed incorrectly or should there be any appreciable loss of liquid, or variations in air pressure, unsatisfactory recoil and run-out must be expected.

The energy of recoil is absorbed mainly between the buffer and recuperator, although a certain amount is taken up in overcoming the friction in the slides and packings. The proportion of work done by the buffer and recuperator in checking recoil depends on the length of recoil. At low angles of elevation and long recoils the greater stress comes on the recuperator, whereas at high elevations and short recoils the buffer does most of the work, therefore, irregular recoils at low elevations are more likely to be due to a faulty recuperator than a faulty buffer; at high elevations the reverse is the case.

Until the spade is fully embedded in the ground, the recoils of the gun will probably be shorter than usual.

The heating of the liquid, due to the rate of fire or length of time in action, will cause it to expand slightly in the buffer and recuperator, with a consequent decrease in its viscosity. This expansion will cause a slight increase in the air pressure of the recuperator, but these changes will not have any practical effect on the length of recoil.

The method of filling the buffer provides for a small air space being left when the buffer and reservoir are correctly filled. Should this precaution be omitted and the reservoir completely filled, then any expansion of the liquid may prevent the gun returning fully to the run-out position. This fault, however, is easily remedied by discharging the surplus liquid past the snifting valve.

The snifting valve must not be operated whilst the gun is at an angle of depression

Variations in atmospheric temperature will have a very important effect on the pressure within the recuperator. The normal pressure per square inch is 600 lb. If the temperature rises or falls, so will the pressure. The limits of deviation of the air pressure for obtaining a satisfactory run-out are dependent on the tightness of the packings, consequently, unless extremes of temperature are experienced little trouble need be expected as a result of the air becoming heated or cooled, and so long as the gun is being taken up to the run-out position with reasonable speed and lack of violence, there should be no need to adjust the recuperator.

Length of recoil

The extreme length of recoil is fixed by the metal-to-metal dimension between the buffer piston and its stuffing box; in this case it is 42 inches. This length should not, however, be reached, as it will lead to damage to the buffer.

The recoil indicator scale is graduated for nominal recoils and the design of the carriage gives clearance at all angles of elevation for the nominal recoils, but in practice, the cut-off gear should be adjusted before these distances are reached.

The nominal length of recoil must, therefore, be viewed in the light of being the maximum permissible, as, if they are exceeded, damage to the equipment will inevitably follow. On the other hand, abnormally short recoils are to be avoided and just as much care is necessary to guard against short as is usually spent in avoiding long recoils.

Control of run-out

The run-out of the gun has an important bearing on the steadiness and service of the equipment. It is effected by the air pressure in the recuperator, consequently, any rise in the pressure above normal will tend to carry the gun more rapidly to the front; any loss of pressure will, on the other hand, tend to a sluggish run-out. The run-out is controlled in the first stage by the retarding valve, but in the final stages the control plunger and run-out adjusting valve are the determining factors. With a given pressure, it will be easier to run out at the lower elevation, owing to the reduced gravity factor. The last few inches being the most important, the whole practical consideration of the question may conveniently be confined to the run-out adjusting valve. This valve is set as the result of proof, and in ordinary circumstances this setting should carry through for a long time. As, however, the valve is easily manipulated, there arises a tendency to attribute every irregularity in the work of the recoil system to the adjusting valve, and recourse is made to it as a general remedy. This is to be deprecated; the valve should rarely require re-setting. Unsteadiness may be caused through the hasty re-setting of the valve, as, for example, when the first rounds give a sluggish run-out due to tight packings the valve is opened, with the result that when the packings work easier the run-out becomes violent. In general, it will be found preferable to leave all such re-setting to skilled personnel.

Loss of air pressure

This may be due to either leakage of air or leakage of liquid, the latter being the more likely cause. Air may pass over the floating piston and cause aeration of the liquid, but otherwise air leakage is unusual. Liquid leakage, on the other hand, does occur, and, by altering the position of the floating piston, affects the air pressure.

It must, however, be quite clear that, in action, the vital test for air pressure is the working efficiency. If the gun is being taken up to the run-out position reasonably and well, there is no need to adjust the recuperator.

The liquid level and air pressure should be tested periodically.

Floating piston

The floating piston performs the threefold function of barrier, intensifier and tell-tale, as described on page 79. Actually, it does not carry out any of these functions perfectly, as experience shows that the packing of the piston head requires attention to maintain it in effective working condition. It is clear that unless the packing is efficient, air will escape over the piston into the liquid, or liquid into the air. These escapes may occur independently or in combination, consequently, the position of the tell-tale is not an absolutely reliable indication of the state of the recuperator. Such escapes, if undetected, may lead to serious damage in action. The escape of liquid into air is particularly liable to cause trouble, and such liquid must be expelled before firing. The tests to ascertain whether escapes are taking place must be carried out frequently, and in all cases before firing takes place.

NOTE.—Should such escapes be excessive, either liquid to air or air to liquid, the recuperator system should be emptied, stripped, and the floating piston repacked at the first opportunity.

Reservoir

The reservoir is for the purpose of ensuring that the buffer is kept filled with liquid, as any air space in the buffer is to be avoided. The liquid in the reservoir becomes hot during firing and expands slightly, causing a small pressure in the reservoir. As a matter of fact, this slight pressure is advantageous, as it ensures the passage of the liquid from reservoir to buffer. The movement of liquid between reservoir and buffer, or *vice versa*, during the period of recoil or run-out may be considered negligible.

2. Packings

Packings are provided at the front of the buffer and recuperator cylinders where the piston rods enter the cylinders, and also on the pistons of the recuperator.

Packings comprise U-shaped rubber rings reinforced by compressed packing rings, S.E.A. rings with compressed packing rings or S.E.A. rings only.

Rubber packings

With certain exceptions, rubber rings are held in position by supporting rings of metal, which are screwed fully home, consequently, there is no question of tightening rubber packings to prevent leakage. The edge of the rubber rings which bears against the piston rod is exposed to the full pressure of the liquid and is so arranged that the greater the pressure the tighter it fits.

Before taking fresh rubber rings into use they should be carefully examined to see that they are in fully serviceable condition.

They should be :—

(*a*) Perfectly sound, that is, not perished in any way.
(*b*) Perfectly smooth and sharp at the edges.
(*c*) Evenly embedded in their position.
(*d*) Handled very carefully during the operation of assembly to avoid damage.
(*e*) Clean and free from grit.
(*f*) Free from flaws or cuts.

Rubber rings will have a preservative coating of collodian varnish and will be issued in sealed grease-proof envelopes.

Upon receipt, the rings will be packed in tins. French chalk will not be used, but in order to prevent damage to the rings they will be kept in their envelopes. In certain instances, where more than one size of packing is stored in the tins, it may be necessary to tear away the centre of the larger envelopes to permit of satisfactory storage. In all such cases sufficient additional paper or cotton wool packing should be inserted, in order to prevent any movement of the rings.

Rings which are coated with collodian varnish will be assembled in the condition in which they are received, provided that the coating is intact. Should the coating be scratched or show signs of flaking off, it will be removed completely by immersing the ring for a few minutes in warm buffer oil and rubbing lightly with the finger. Care must be taken not to distort the ring or damage its surface in the process.

Any coating which cannot be removed by immersion in warm oil is unlikely to cause trouble in the recoil system, and should be left on. If, however, a partially stripped coating should be met with, which does not respond to the warm oil treatment, there is no objection to removal by gently rubbing with a piece of soft rag soaked with cellulose thinners or amyl acetate (if available).

Rubber packings issued without the preparation described above will be packed in french chalk in tins and sealed with adhesive tape ; the tins should only be opened when packings are required for use and again sealed after withdrawal of the necessary rings.

Compressed packing rings

The compressed packing rings are of special manufacture and pressed into shape ; with the recuperator piston a special form of packing, fitted with slugs, is supplied.

They are inserted between metal rings or sleeves, and are so arranged that they can be pressed tightly on the moving surface by glands.

The packing rings should be wrapped in oiled paper and stored in tins, boxes, or any suitable receptacle, so that the shape and finish may be maintained. They should be kept as far as possible in an even temperature.

Before being taken into use, they are to be carefully inspected to see that they are fully serviceable.

In future, all packings will be supplied in tinned-plate containers, designed for the protection of spare packing rings when in transit, storage, and against climatic conditions. Each container is designed to contain one packing ring, the dimensions of which correspond approximately to the internal dimensions of its container.

After filling, the containers are hermetically sealed and tested, and a contents label is affixed to the under side. The number of the container and Part No. are stamped on the lid.

S.E.A. packings

With the recuperator pistons, adjustments to packings are not necessary as the rings face the pressure, therefore, if correctly assembled, clean and in good condition, they are not likely to permit leakage. Should they be cut or rest on a gritty surface, etc., trouble may readily arise.

Care should be taken that the securing nut of the S.E.A. packings is only hand tight.

Treatment of new packings

After assembling the packings of the recuperator or floating piston, the exterior of the rings should be well smeared with a mixture of graphite and mineral jelly in order to reduce friction between the packings and the cylinder walls and also to facilitate assembly of the piston into the cylinder. Where U-shaped rings are used in stuffing boxes, etc., the parts in contact should be well rubbed with the mixture before being assembled into their respective position.

In every case before applying the mixture, care must be taken to ensure that the packings are free from grit, or any foreign matter whatsoever. A similar precaution should also be observed as regards the mixture. If the graphite and mineral jelly mixture is not available, the various packings should be dipped, before assembly, in clear oil similar to that used in the recoil system.

In no circumstances will tallow be used for smearing the packings.

With floating pistons, packings will, on assembly, be treated with graphite grease, precautions being taken as in the preceding paragraph regarding the presence of grit or foreign matter.

Leakage

The object of all such packings is to prevent liquid leakage, consequently, when leakage is observed, an inspection of the packings should be carried out. With the gun and equipment fully assembled, liquid leakage from all three packings shows itself by dripping at the rear of the cradle when the gun is elevated slightly. To determine which packing is at fault, the hinged door on the lower surface of the front cap should be opened and the gland packings inspected. Internal leakage over the floating piston head is dealt with on page 83.

Having located which packing is at fault, the appropriate remedy should be applied, either by tightening or repacking.

Tightening glands

The operation of tightening glands must be carried out with discretion, as a gland which is too tight is just as likely to cause leakage as one which is not tight enough, moreover, undue tightness in the gland is detrimental to the run-out of the gun and to the wear of the working parts.

When glands are tightened or packings adjusted or replaced, the gun must be pulled back a foot or so by means of the pulling back apparatus and then released to

test the efficiency of the run-out. This operation must be repeated two or three times and the packings adjusted, if necessary, until a satisfactory run-out is obtained.

If a leakage cannot be stopped, or kept within reasonable limits by judicious tightening, a supplementary packing ring must be inserted, or if a supplementary ring is already in use, the defective packing must be replaced by a new ring. Should the leakage continue, the cylinder block must be removed and sent for repair, being replaced by a spare block. In some cases it may be more convenient to return the complete carriage to the workshop.

The glands, therefore, should be inspected as often as opportunity permits and tightened if necessary. Such inspection must be carried out before firing, and, if possible, during pauses, in, or after, action.

A gland packs better if tightened when the packings are hot from firing, e.g. during pauses in action.

When tightening a packing ring the gland should not be screwed home until the flange is metal-to-metal with the stuffing box.

Tightening of glands by artillery personnel should be done very carefully and only in emergency.

3. The careful observation of the system, both in and out of action

Before leaving the gun park, it should be seen that the recoil and recuperator systems are correctly filled and charged ; that the cylinder block is firmly secured to the gun ; that the piston rods are securely nutted to the front cap ; that there is no leakage at either of the glands or piston packing ; that the cut-off gear is assembled ; also the plugs H, M, N, and cover L have washers and are properly screwed home.

During a halt, a rapid survey of the recoil arrangements should be made, to ascertain that all is in order, with particular attention to leakage past the packings.

When ordered to prepare for action, the glands should be inspected for signs of leakage and, if necessary, tightened. Care should be taken that the gun is properly connected up and that all securing nuts are fully home, with keep pins in position. The recuperator system should be tested for liquid level and air pressure. If considered necessary it should be re-charged.

During action, air may be taken into the buffer, past the gland, as the gun runs out after recoil. The amount will be small, but in time an air pocket may form in the buffer, of such dimensions as will prevent the gun returning fully to the run-out position, or it may cause the recoils to be irregular, with a tendency towards violence. To remedy this, press in the snifting valve, until all froth has disappeared from the discharge.

The run-out adjusting valve can be adjusted during action if necessary, *this should, however, be left to skilled personnel.*

In general, the functioning of the system should be carefully watched, and steps taken to apply remedies at once. From the foregoing remarks, it may be seen that the length of recoil must not be expected to remain constant from round to round. The best way to maintain the system in good working order is for the No. 1 to keep a close watch on the recoil and run-out, being particular to note whether the action is smooth or jerky, whether the carriage remains steady and whether the run-out is continuous and complete. These points are of greater importance, generally speaking, than critical observation of the exact length of recoil, the exact pressure in the recuperator or the amount of liquid in the system. In other words, the recoil system, in action, should be judged by results rather than by tests.

The following are the more common faults :—

(For any given fault the causes and remedies are set out in the sequence which should be followed to ascertain the particular cause and remedy, so that the simplest and most readily removed causes may be eliminated before proceeding to the more difficult.)

Fault	Cause	Remedy
Recoil violent or excessive	Air in buffer cylinder.	Operate snifting valve.
	Insufficient liquid in buffer.	Fill buffer and reservoir.
	Reduced air pressure in recuperator.	Test and re-charge recuperator.
	Wear of piston and valve.	Adjust by cut-off gear.
Recoil short	Excessive air pressure.	Test and release surplus.
	Damaged slides.	Examine and repair.
	Wrongly set cut-off gear.	Test and adjust gear.
	Excess of liquid in recuperator.	Test and re-charge recuperator.
	Packings too tight.	Repack.
Run-out incomplete ..	Run-out adjusting valve incorrect.	Open valve.
	Burrs or grit on slides.	Remove obstruction.
	Reduced air pressure.	Test and adjust pressure.
	Packings too tight.	Repack.
Run-out violent	Run-out adjusting valve incorrect.	Close valve further.
	Excessive air pressure.	Test and release surplus.
	Retarding valve fast in open position.	If this is suspected and a few rounds fail to move it, then strip recuperator and replace valve.
Failure to run-out ..	Air in buffer.	Operate snifting valve.
	Run-out adjusting valve closed.	Open valve.
	Burrs or grit on slides.	Remove obstruction.
	Reduced air pressure in recuperator.	Test and adjust pressure.
	Packings too tight.	Repack.

NOTE 1.—Reduced air pressure may be due to air alone, or may be caused by leakage of liquid from the recuperator; the precise cause should be ascertained. Should the ordinary outside adjustments fail to give satisfactory results, the cylinder block should be removed and replaced by a spare block.

NOTE 2.—Should the gun fail to run-out completely, it is nearly always possible to bring it to the firing position by depressing and pushing it forward, and then any necessary valve adjustment can be made.

Pitting

Occasionally it is found that the buffer and recuperator cylinders show indications of corrosion and pitting. To avoid this, the gun is to be pulled back in its cradle for a foot or so at least once a month, using the No. 7 pulling-back apparatus.

GENERAL PRECAUTIONS

To ensure that buffers and air recuperators are kept in good order, it is important that adjustments or repairs to them must be carried out by artificers, care being taken to avoid ingress of grit or foreign matter. Consequently, when a defect develops in a buffer or recuperator on service, no attempt will be made to repair it whilst it is in the firing line. Instead, the complete cylinder block will be removed from the cradle and replaced by a spare one.

When cylinder blocks are received from R.E.M.E. stencilled FILLED AND CHARGED, it must be ascertained that the buffer and recuperator are correctly filled and charged, when all stencilled information relating thereto should be obliterated.

During severe weather, buffers and recuperators must be protected as much as possible from the cold, in order to prevent the liquid contents from becoming frozen. They may be covered with sand bags, sacking or straw, and, if in gun pits, the use of braziers or stoves is most beneficial.

Service buffer oil should remain unfrozen down to a temperature of 20 degs. Fahr.

Should the liquid become frozen, firing must not take place ; steps will be taken to thaw the liquid, but if there is any doubt as to whether freezing has caused damage, the cylinder block will be removed for investigation and replaced by a spare block.

To ascertain if the liquid in the buffer is not frozen, open the snifting valve and liquid should flow. For the recuperator, remove cover L and insert testing tool, open the tool and liquid should flow. Elevating and depressing the gun or pulling the gun back in the cradle, all tend to prevent the liquid freezing.

Before the recuperator is emptied or disconnected from the carriage, the gun must be securely fastened to the cradle to prevent it from sliding back. This may be effected by inserting the running-back stop or by lashing the gun to the cradle. Whilst in this condition the cradle should not, except for special reasons, be elevated.

If the carriage is to remain long in this position the elevating hand wheel must be lashed or removed.

The safety collar must not on any account be removed from the recuperator piston rod until all air pressure has been released, otherwise the piston and rod will be blown out violently to the rear of the carriage.

On no account will the stuffing box of the H.P. cylinder be unscrewed before it is established *beyond doubt* that the air pressure has been entirely released. To ensure this, the following procedure will be carried out under the supervision of the foreman or other responsible person authorized by an O.M.E. :—

Remove plug H. Unscrew air valve K at least four complete turns. Wait until the sound of escaping air has ceased. Carefully remove the valve gland and packing, then unscrew the valve and remove it from the block. During this operation, as an additional precautionary measure, care will be taken to ensure that no person is standing in a direct line with the valve. See that the hole between the valve seating and the H.P. cylinder is clear. Removal of the H.P. cylinder stuffing box and floating piston can then proceed in the normal manner.

Great care is necessary to see that the recuperator is correctly filled, as too much liquid may cause serious damage and put the gun out of action.

It is essential that the buffer is correctly filled and that the reservoir contains liquid at all times in action.

When replacing the stuffing boxes, etc., the locking arm must be placed in position and the fittings in correct alignment.

Should the cut-off gear be damaged so as to prevent its working, the locking lever of the bevel segment is locked at 20 inches recoil. In this position a fixed length of recoil is obtained ; this is the minimum, and is of the same length at all angles of elevation.

LIQUIDS

The liquid officially authorized for use in hydraulic buffers and recuperators is Hydraulic buffer mineral oil, sometimes referred to as Service buffer oil, to specification C.S.1117A or B. A 2 to 1 mixture of service buffer oil to this specification and white spirit to specification C.S.995 will be used in sub-cold climates (Zero to —60 degs. Fahr.).

Under peace conditions, no other liquid whatever is to be used as an alternative.

On active service, should the supply of buffer oil fail, any ordinary lubricating oil may be used, and in extreme cases even water may be employed. These alternative liquids may quite possibly cause grave damage to the recoil system if they are retained in the cylinder for any length of time, consequently, every effort should be made to obtain a supply of buffer oil as soon as possible, on receipt of which the emergency liquid should be removed.

Under no circumstances whatever will illuminating oils, such as paraffin, kerosene or explosive oils like petrol, etc., be used.

The liquid must be dry and clean, consequently, before using any liquid it must be decanted and strained, particles of dust should be excluded from filling and air

holes, and the whole operation of filling performed with as much freedom from dust as possible.

Oil emptied from buffers or recuperators must not, except in great emergency, be used again in the cylinders.

The receptacles employed for storing and transporting buffer oil must be proof against the ingress of moisture, and care must be taken to see that the oil is kept thoroughly " dry," that is, quite free from any admixture with water. The presence of water in the oil has a serious effect on the cylinders; every precaution will be taken to avoid any trouble arising from this cause.

For this reason receptacles containing buffer oil are to be carefully handled to avoid denting or damaging them during transport, and they will not be opened until actually required for use, care being taken not to damage the sealing caps, after which, if not empty, they will be carefully resealed. They should not be left out in the open.

TO CHARGE THE RECOIL SYSTEM

This operation may be performed either with the cylinder block assembled in position on the carriage, or with the cylinder block assembled off the carriage.

In each case the operation should be carried out in the following sequence :—

1. Prepare the recuperator with liquid.
2. Charge the recuperator with air.
3. Fill the buffer system with liquid.

NOTE.—The pressure gauge should not be read whilst air is passing either into or out of the cylinder, as such a reading is quite unreliable.

The cylinder block assembled on the carriage

1. To prepare the recuperator with liquid

(*a*) Ascertain that the gun is in the fully run-out position.

(*b*) Lash the gun to the cradle or place in position the running-back stop to prevent the gun running back.

(*c*) Elevate the gun to approximately 10 degrees.

(*d*) Remove plug H and open valve K of air reservoir, to facilitate the placing of the floating piston.

(*e*) Remove the plug N from the cylinder block.

(*f*) Ascertain that the safety collar is correctly assembled on the recuperator rod and secured by a keep pin.

(*g*) Unscrew the floating piston rod cover to obtain access to the rod.

(*h*) Place the floating piston so that the end of the rod is 4·75 inches from the face of the cylinder block, i.e. 1·2 inch further into the cylinder than normal.

(*i*) Screw the No. 17 adapter into the plug hole N of the recuperator and connect up the delivery nozzle of the portable liquid pump.

(*j*) Ascertain that the receptacle for the oil is empty and perfectly clean and pour in 12 pints of oil.

(*k*) Place the suction nozzle of the pump into the receptacle and pump oil until it flows freely from the plug hole N of the hydro-pneumatic cylinder.

(*l*) Disconnect the pump and adapter and replace both plugs.

NOTE.—The quantity of liquid contained in the recuperator is approximately 9 pints.

2. To charge the recuperator with air

NOTE.—*When an empty recuperator has to be charged, an application will be submitted to the R.E.M.E. for this service.* Dry air will be used.

Air reservoirs held on charge by units are to be used *only for replacing air lost* subsequent to initial charging.

The following instructions indicate the procedure to be followed when using the pump, which should only be adopted in cases of *extreme emergency*.

(*a*) Bring the gun horizontal and see that the recuperator has been correctly prepared with liquid as in 1.

(*b*) Ascertain that the gun is in the fully run-out position and secured as in 1 (*b*).

(*c*) Place the No. 5 horizontal air pump in position on the trail.

(*d*) Fix the No. 1 pump adapter with the No. 16 pressure gauge in the filling hole H and connect up the adapter to the pump by the flexible hose.

(*e*) Open valve K and operate the pump until the pressure gauge reads 630 lb. per square inch.

(*f*) Close valve K, disconnect the pump hose and fit the blank cap to the adapter.

(*g*) Ascertain if the floating piston is now at its normal position, i.e. 5·95 inches from the end of the rod to the face of the cylinder block. If short of this dimension, release liquid by opening plug N about one turn only until the rod is in the normal position. If in advance of normal, remove plug L, screw in position the suction and force hand pump and continue pumping until the rod is in its normal position.

(*h*) Check the air pressure by opening valve K and adjust to 600 lb. per square inch by unscrewing the blank cap one turn, then close valve K.

(*i*) Remove the adapter and pressure gauge and replace plug H.

3. To fill the buffer system with liquid

(*a*) Ascertain that the gun is in the fully run-out position and secured as in 1 (*b*).

(*b*) Elevate the gun to approximately 10 degrees.

(*c*) Remove plug M from the reservoir.

(*d*) Screw the oil filling adapter into hole M.

(*e*) Ascertain that the oil receptacle is empty and perfectly clean and pour 18 pints of oil.

(*f*) Connect the delivery nozzle of the portable liquid pump to the adapter.

(*g*) Place the suction nozzle of the pump into the liquid receptacle, press open the snifting valve and pump liquid slowly until oil flows freely over the snifting valve.

(*h*) Release the snifting valve to the closed position and continue pumping until the reservoir is full.

(*i*) Disconnect the pump and adapter and replace plug M.

(*j*) Elevate and depress the gun to extreme limits, pressing the snifting valve frequently to ensure that all air is released from the buffer.

(*k*) See that the recuperator has been correctly filled and charged as in 1 and 2 and remove the lashing or the running-back stop and elevate the gun to 12 degrees elevation.

(*l*) Pull back to corresponding recoil, release the pulling-back apparatus and allow the gun to run out.

If possible, pull back at least three times, adjusting the packings as necessary to give satisfactory run-out.

The quantity of liquid contained in the buffer and reservoir when correctly filled is approximately 15 pints. The level of the liquid can be ascertained from the dipstick on plug M, when the gun is horizontal.

The cylinder block assembled off the carriage

The method of filling and charging with the cylinder assembled on the carriage is applicable also when the block is assembled off the carriage.

It is imperative that the recuperator is pulled back as soon as possible after filling and charging to ensure satisfactory adjustment of packings.

TESTS FOR BUFFER AND RECUPERATOR SYSTEM

Test 1.—To ascertain whether the recuperator contains the correct quantity of liquid

(*a*) Lay the gun horizontal, longitudinally and transversely.

(*b*) See that the gun is in the fully run-out position.

(*c*) The tail-rod should then be in the normal position.

(*d*) The recuperator is correctly charged when the end of the rod is 5·95 inches

from face of cylinder block or flush with the rear end of the slot in the floating piston rod cover.

(*e*) If the tail-rod is in advance of the normal position by more than 1 inch, liquid must be inserted by means of the force pump.

(*f*) If time is important, the liquid packing may be considered serviceable so long as the tail-rod does not exceed the limit shown in (*e*).

Test 2.—To ascertain whether the recuperator contains the correct air pressure

(*a*) Test for liquid as in *Test* 1.

(*b*) Lay the gun at 10 degrees elevation and see that it remains in the run-out position.

(*c*) Remove the plug H and insert the adapter with pressure gauge and blank cap.

(*d*) Open valve K two turns.

(*e*) Pressure gauge should register 600 lb. per square inch.

(*f*) If higher pressure is recorded, unscrew the adapter cap one turn and allow pressure to fall to 600 lb. per square inch, then close valve K.

(*g*) If lower pressure is recorded, close valve K, connect up the reservoir or pump, re-open valve K and re-charge.

(*h*) If time is of importance, the pressure may be taken as serviceable if it is between 500 and 650 lb. per square inch.

(*i*) Remove the adapter and gauge; elevate to the maximum elevation and the gun should not slip back.

(*j*) Replace plug H.

Test 3.—To ascertain whether the buffer is correctly filled

(*a*) Lay the gun horizontal.

(*b*) Remove plug M and see that the oil in reservoir reaches to the bottom of plug M.

(*c*) Press snifting valve open until a free flow of oil is obtained then release snifting valve to the closed position.

(*d*) Make up leakage to the above level, using the cylinder filling funnel.

(*e*) Replace plug M.

Test 4.—To test and adjust for liquid in the air reservoir

(*a*) Secure the gun to the cradle.

(*b*) Place the gun at 30 degrees elevation.

(*c*) Remove plug H.

(*d*) Open air valve K *one turn*.

(*e*) Liquid, if present, will be forced out of H.

(*f*) When air only is escaping close valve K.

(*g*) Bring the gun horizontal and release the securing apparatus at (*a*).

(*h*) Test the air pressure and, if necessary, re-charge.

NOTE.—It is advisable to make up liquid leakage from the recuperator before re-charging with air.

Test 5.—To test and adjust for aeration of liquid in the recuperator

(*a*) See that the recuperator and buffer piston rods are properly nutted up and that the gun is in the fully run-out position.

(*b*) Lay the gun at approximately 10 degrees elevation.

(*c*) See that the tell-tale rod of the floating piston is in the normal position, i.e. its front end flush with the rear edge of the slot in the floating piston rod cover. If necessary, make up loss of liquid as on page 92.

(*d*) Unscrew plug N of H.P. cylinder by *not more than one complete turn*.

(*e*) If clear liquid flows there is no aeration and the plug should be screwed home.

(*f*) If the flow is frothy, aeration is indicated and the plug should be left unscrewed until all frothy liquid is expelled and a clear flow is obtained. Screw home plug N.

(*g*) Make up liquid as described on page 92.

GENERAL INSTRUCTIONS

NOTE.—Operations which include the removal of glands, packings, stuffing boxes, etc., are not to be carried out in the open, but must be performed by artificers under conditions which will prevent the ingress of grit or foreign matter.

To make up liquid leakage from the recuperator without blowing off air pressure

(*a*) See that the gun is in the fully run-out position.
(*b*) Expel all liquid from the air reservoir by carrying out *Tests* 4 and 5.
(*c*) Lay the gun horizontal.
(*d*) Place the running-back stop in position.
(*e*) Remove the floating piston rod cover.
(*f*) Attach the No. 246 artillery tool, by screwing in place of the cover at (*e*). Turn the handle of the tool in a clockwise direction until contact is made with the end of the tell-tale rod and continue until the air pressure on the rod is taken up. Then unscrew plug N of the recuperator cylinder. Insert a filling funnel and fill it with buffer oil.
(*g*) Continue forcing back the floating piston until the rod has moved back about 0·5 inch beyond its normal position (the end of the rod should be flush with the end of the slot in the tool for the normal position). The oil should be overflowing from plug N when the funnel is removed.

NOTE.—If no funnel is available, use the No. 2 liquid pump and the No. 17 adapter.

(*h*) Replace and tighten plug N.
(*i*) Turn the handle of the tool in an anti-clockwise direction until the pressure is removed, and then unscrew the tool from the front cap.
(*j*) Replace the floating piston rod cover.
(*k*) Elevate the gun to approximately 10 degrees.
(*l*) Unscrew plug N of the recuperator cylinder *not more than one complete turn* to release any trapped air. Tighten plug N.
(*m*) Reposition the floating piston until the end of the rod is in its normal position by unscrewing plug N of the hydro-pneumatic cylinder *not more than one complete turn* to permit a little oil and any trapped air to escape. Tighten plug N.
(*n*) Remove the running-back stop.

To make up air pressure in the recuperator

(*a*) See that the gun is horizontal, in the fully run-out position, and that the tell-tale is 1·2 inch inside the normal by charging with liquid if necessary.
(*b*) Remove plug H and connect up the reservoir or pump through the adapter and pressure gauge.
(*c*) Open valve K two turns.
(*d*) Allow air to pass from the reservoir or pump air in until a pressure of 630 lb. per square inch is recorded.
(*e*) Close valve K, elevate to maximum elevation, when the gun should not slip back.
(*f*) Disconnect the reservoir or pump and place the blank cap on the adapter.
(*g*) Unscrew the blank cap on the adapter one turn.
(*h*) Adjust the tell-tale by plug N to normal if necessary.
(*i*) Open valve K and bring pressure down to 600 lb., close valve K.
(*j*) Remove the adapter and gauge, replace plug H.

NOTE.—When making up air pressure with the compressed air reservoir and pressure gauge, it is imperative that valve K is opened before the reservoir valve. When the desired air pressure is registered on the pressure gauge close the reservoir valve *before* closing valve K. This will avoid excessive pressure from the reservoir being passed into, and damaging, the pressure gauge.

When using the above method, the pressure gauge should read approximately 10 lb. above the desired pressure. This allows for the subsequent loss of pressure contained in the connecting pipe.

To make up liquid leakage in the buffer

Fill the buffer as detailed on page 90.

To tighten glands

(*a*) With the gun horizontal and properly secured to the cradle, insert a screw-driver in the hole provided in the cradle cap and lift the locking arm clear of the gland concerned.

(*b*) Apply the spanner provided to the gland, and rotate it clockwise to the extent required.

(*c*) Remove the running-back stop or lashing, and pull the gun back as often as may be necessary, whilst adjusting, to obtain a satisfactory run-out.

To empty the system

This operation may be carried out with the cylinder block in position on the carriage, or the block may be removed from the equipment. The latter must be considered the normal method.

In this case the procedure to be adopted is as follows :—

(*a*) Place the cylinder block horizontal.

(*b*) Remove plug H, open valve K and allow the air pressure to be exhausted.

(*c*) Unscrew the stuffing box of the liquid cylinder. Remove plug N and allow the liquid to run off into a receptacle.

(*d*) The retarding valve should be moved off its seating, removing the piston rod if necessary and the block raised and lowered at one end to drain the system.

(*e*) Remove the stuffing box from the buffer cylinder. See that the snifting valve is removed and allow the liquid to run off into a receptable.

(*f*) The liquid will be critically examined and must not, *except in great emergency*, be again used in the system.

Should the operation have to be carried out whilst the cylinder block is in position on the carriage, the gun must first be secured to the cradle to prevent movement.

To remove cylinder block

(*a*) Lay the gun horizontal.

(*b*) Unscrew the bolts securing shield and remove shield.

(*c*) Unscrew the screws securing cotters and remove cotters.

(*d*) Unscrew the screws securing strap and lift gun off cylinder block.

(*e*) Remove the nuts securing piston rods, disconnect cut-off gear and remove cradle cap.

NOTE.—See that the cotter pin is correctly assembled on cut-off gear before disconnecting.

(*f*) Withdraw cylinder to the rear, care being taken to avoid damage to liners.

Alternative method

(*a*) Lay the gun horizontal.

(*b*) Remove the nuts securing piston rods, disconnect cut-off gear and remove cradle cap (*see* Note at (*e*) above).

(*c*) Pack up under the rear of cradle to ensure that the elevating gear does not slip when gun and cylinder block are being withdrawn.

(*d*) Withdraw gun and cylinder block to the rear, care being taken to avoid damage to liners.

(*e*) Unscrew the screws securing cotters and remove cotters.

(*f*) Unscrew the screws securing strap and lift gun off cylinder block.

NOTE.—In view of the weight of gun and cylinder block, approximately 12 cwt. 1 qr. 14 lb., a platform built up to straddle the trail and equivalent in height to the bottom liners of cylinder block (cradle horizontal), would greatly facilitate its removal.

After withdrawing the cylinder block with the gun from the cradle on to the platform, run the carriage forward clear of the platform.

NOTE.—After each of the following operations 1 to 9, the gun must be pulled back in accordance with instructions 3 (*k*) and (*l*) on page 90.

1. To replace the joint ring of the buffer

(*a*) Secure the gun to the cradle and disconnect the cut-off gear, noting the setting mark.

(*b*) Elevate the gun to a convenient working position, due consideration being given to prevent loss of liquid.

(*c*) Remove the securing nuts of recuperator and buffer piston rods.

(*d*) Remove the cradle cap. (If the recuperator is charged with air, the safety collar of the recuperator piston rod inside cradle cap must not be removed, as this block bears against the recuperator gland and prevents the piston from being forced out to the rear when under pressure and disconnected from cradle cap.)

(*e*) Remove the glands locking arm and the stuffing box with gland from the buffer piston rod and renew the defective joint ring.

(*f*) Replace the stuffing box, gland, cradle cap, nuts of piston rods and the glands locking arm.

(*g*) Lay the gun horizontal. Connect up the cut-off gear to the known setting mark and fill the buffer system.

2. To replace or reinforce the buffer compressed packing ring

(*a*) Remove the stuffing box and gland as in 1, paras. (*a*) to (*e*).

(*b*) Remove the gland, front supporting ring and packing ring if unserviceable.

(*c*) Prepare the new packing ring, or supplementary ring in the case of reinforcement.

(*d*) Insert the new ring and replace the front supporting ring.

(*e*) Ensure that the joint ring is in good order.

(*f*) Proceed as in 1, paras. (*f*) and (*g*).

3. To replace or reinforce the compressed packing ring of the recuperator liquid cylinder

(*a*) Secure the gun to the cradle and disconnect the cut-off gear noting the setting mark.

(*b*) Remove plug H from the air reservoir, open valve K allowing air to escape if recuperator is charged.

(*c*) Remove the nuts securing piston rods of buffer and recuperator.

(*d*) Remove the glands locking arm, cradle cap, and safety collar from recuperator piston rod and stuffing box.

(*e*) Remove the gland, front supporting ring and packing ring, if unserviceable.

(*f*) Prepare the new packing ring, or supplementary ring in the case of reinforcement.

(*g*) Insert the new ring and replace the front supporting ring.

(*h*) Replace the stuffing box, gland, safety collar, cradle cap, nuts of piston rod and the glands locking arm.

(*i*) Lay the gun horizontal and connect up the cut-off gear to the known setting mark.

(*j*) Re-charge the recuperator system.

4. To replace the U-rubber or joint ring of the recuperator liquid cylinder

(*a*) Remove the stuffing box as in 3, paras. (*a*) to (*d*).

(*b*) Remove the dust excluder and withdraw the piston rod to the rear to facilitate draining the cylinder.

(*c*) Remove the defective U-rubber or joint ring together with the retarding valve and seating.

(*d*) Prepare the new U-rubber, if required.

(*e*) Replace the piston rod and retarding valve with seating; assemble and replace the U-rubber, joint ring and supporting ring with the stuffing box.

(*f*) Proceed as in 3, paras. (*h*) and (*j*).

5. To replace or tighten the packing rings of the recuperator piston

(*a*) Remove the piston rod as in 4, paras. (*a*) and (*b*).
(*b*) Remove or tighten the packing rings as required.
(*c*) In the case of renewal, prepare the new packing rings and assemble them on the piston rod.
(*d*) Replace the piston rod, etc., as in 4, para. (*e*).
(*e*) Proceed as in 3, paras. (*h*) and (*j*).

6. To replace the joint ring of the H.P. cylinder

(*a*) Proceed as in 3, paras. (*a*) to (*c*).
(*b*) Elevate the gun to a convenient position for working, due consideration being given to prevent loss of liquid, and remove the cradle cap.
(*c*) Unscrew the stuffing box, withdraw it clear of the tail-rod and renew the defective joint ring.
(*d*) Replace the stuffing box, glands locking arm, cradle cap and securing nuts of piston rod.
(*e*) Lay the gun horizontal and connect up the cut-off gear to the known setting mark.
(*f*) Re-charge the recuperator system.

7. To replace or reinforce the H.P. cylinder compressed packing ring

(*a*) Remove the stuffing box as in 6, paras. (*a*) to (*c*).
(*b*) Remove the gland extension tube and packing ring, if unserviceable.
(*c*) Prepare the new packing ring or supplementary ring in the case of reinforcement.
(*d*) Insert the new ring, extension tube and gland.
(*e*) Proceed as in 6, paras. (*d*) to (*f*).

8. To replace the U-leather in the H.P. cylinder

(*a*) Remove the stuffing box as in 7, paras. (*a*) and (*b*).
(*b*) Remove the supporting ring and defective U-leather.
(*c*) Prepare the new leather ring.
(*d*) Insert the new leather ring and replace the supporting ring, compressed packing, extension tube and gland.
(*e*) Proceed as in 6, paras. (*d*) to (*f*).

9. To adjust or replace the packings of the floating piston

(*a*) Remove the stuffing box as in 6, paras. (*a*) to (*c*).
(*b*) Withdraw the floating piston from the H.P. cylinder.
(*c*) Adjust or replace the packings as required.
(*d*) Replace the floating piston and proceed as in 6, paras. (*d*) to (*f*).

NOTE.—Care should be taken that on assembly the nut securing packings is screwed home only hand tight and split pin placed in position.

TO TEST AND ADJUST THE CUT-OFF GEAR

(Fig. 37)

Due to the conditions of storage and supply, or to parts becoming worn or damaged, necessitating replacement by others, small errors in the setting of the cut-off gear may be introduced through variations in fitting, consequently, to ensure that the gear is working correctly, it is necessary to test :—

(*a*) When the equipment is first issued to the unit.
(*b*) On completion of overhaul.
(*c*) When any part of the buffer or cut-off gear has been changed.
(*d*) Periodically.

On completion of the test, the gear should be reset if necessary, but no adjustment or alteration to the cut-off gear may be carried out except on the authority of an E.M.E.

To test

(*a*) Place the wheels and trail on the same level, i.e. wheels on ground level and spade box in position over the spade.

(*b*) Lay the gun horizontal longitudinally and transversely.

(*c*) Secure the gun in the cradle by the running-back stop.

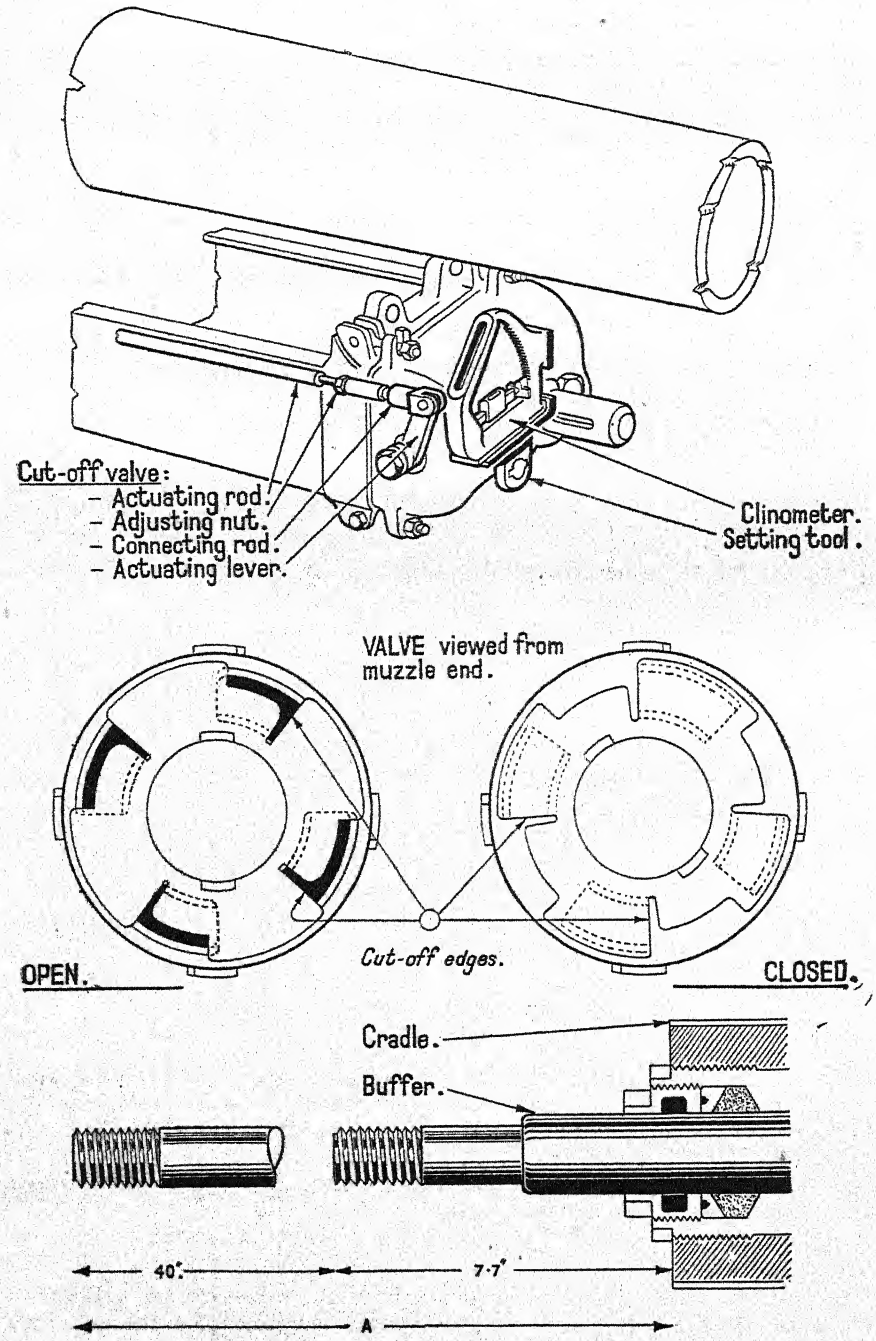


FIG. 37

(*d*) Disconnect the cut-off gear, remove the buffer piston rod nuts, locking lever and cradle cap.

(*e*) Remove the stuffing box and withdraw the buffer piston rod completely from the buffer cylinder. Drain off oil into a receptacle.

(*f*) Withdraw the keep pin and remove the rotating valve with all fittings. Replace the rotating valve with its fittings and securing nut, placing a packing washer in position between the thrust ring or boss of valve, and securing nut. Position the rotating valve so that the ports are completely closed against the sliding valve. Now tighten up the securing nut firmly. It is most important that the cut-off edge of the valve and the piston ports remain in line after clamping.

(*g*) The buffer rod completely assembled is now inserted in the cylinder and the stuffing box replaced.

(*h*) Place the rod so that the distance A from the front of the cylinder block to the end of the rod marked B is 47·7 inches.

(*i*) Place the setting tool (No. 247 artillery tool) on the end of the rod over the keyways. Now place the clinometer on the plane of the setting tool, and measure its angular inclination by bringing the bubble to the centre of its run, taking careful note whether the arc of the clinometer is to the right or left.

To set the piston rod

(*a*) Remove the clinometer, setting tool and stuffing box, and withdraw the piston rod carefully from the cylinder.

(*b*) Check to see that the ports of the piston and valve are still closed and cut-off edges are in line. This is most important.

(*c*) Release the securing nut and remove the packing washer. Secure the nut as originally fitted and replace the keep pin. Insert the piston complete, in the cylinder.

(*d*) Replace the stuffing box and gland, and fill the buffer with oil.

(*e*) Replace the cradle cap and remove the locking lever and replace the setting tool in position on the keys on the piston rod and press same into the cap.

(*f*) Connect up the cut-off gear, place clinometer on the plane of the setting tool, and by means of the adjusting nut on the actuating rod bring the reading on the clinometer to the angle obtained in (*i*) *To test*, care being taken to see that the arc of the clinometer is to the left or right as used previously.

(*g*) Turn the adjusting nut until the cotter can be inserted easily. Should difficulty be experienced in getting the holes in exact alignment, half a turn of the nut in either direction will not materially affect the setting. It should, however, be made in the direction of SHORTEN, if the amount does not exceed one quarter of a turn.

(*h*) Remove the clinometer and setting tool. Replace the locking lever and piston rod nut with its keep pin.

(*i*) Unlash the elevating hand wheel and unlock the wheels, releasing the brakes and removing the scotches.

SIGHTING

The sights (Fig. 38) are carried on the left side of the carriage, and comprise a carrier with a range scale in the form of a cone, sight clinometer and No. 7 to 7C, 9 or 10 dial sight.

The dial sight is used for laying for direction and gives an all-round field of view. The range scale is set to the range and the sight clinometer to the angle of sight, in order to complete the laying for elevation. Provision is, however, made for the necessary adjustments in this plane.

The sights are reciprocating, that is to say, they can be cross-levelled in such a manner as to retain their verticality when the wheels of the carriage are out of level, up to a limit of ten degrees either way, and so correct for the error in line which would otherwise ensue.

A cross-level bubble, with cross-levelling gear, effects the correction, the oscillating bracket being hinged to the supporting bracket for this purpose.

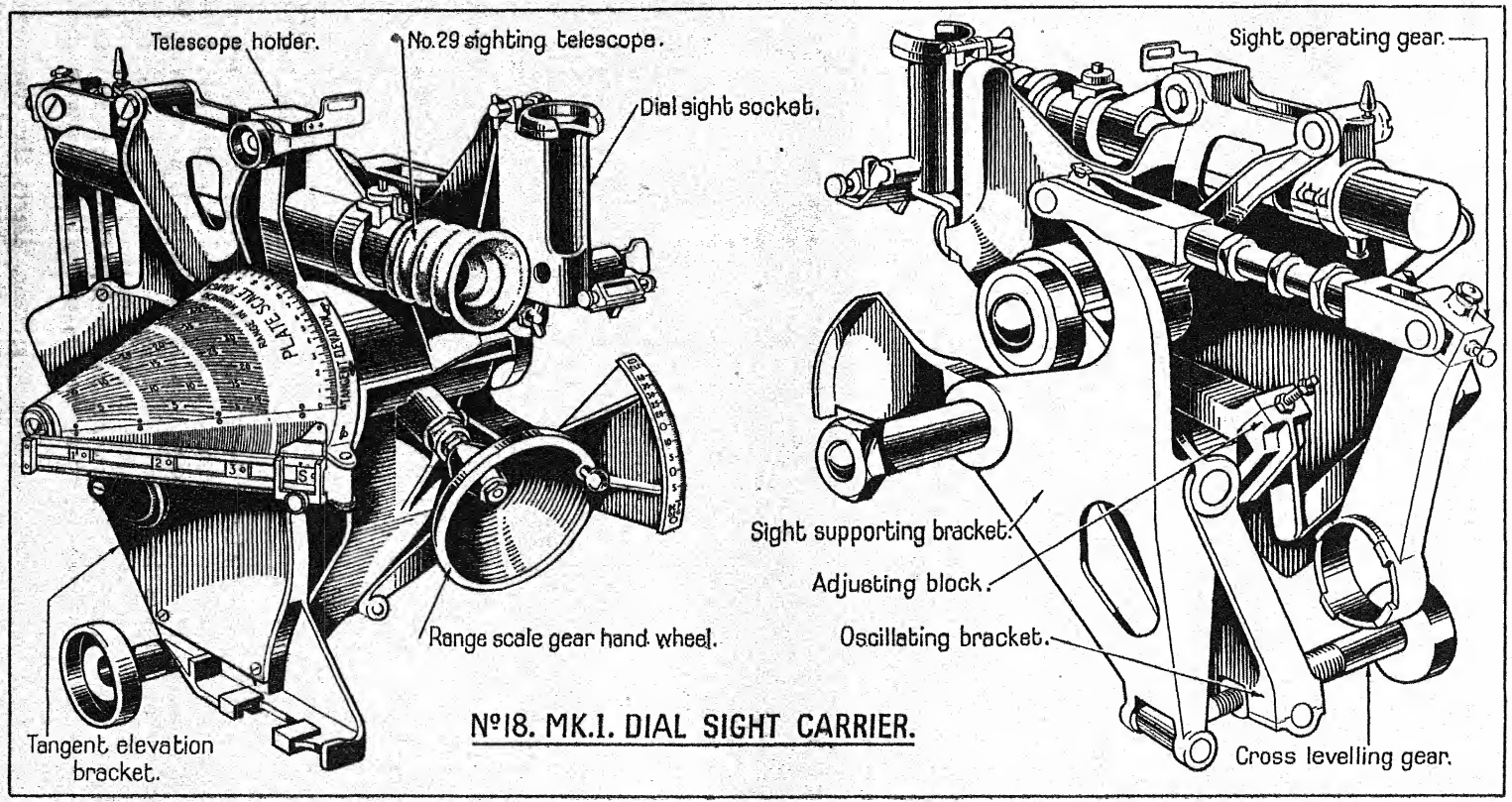


FIG. 38.

Nº18. MK.I. DIAL SIGHT CARRIER.

Furthermore, the correction for drift is automatically applied by the act of cross-levelling, owing to the cross-level bubble being set at an inclination by the cam of the drift scale plate (the drift angle) to the true transverse axis of the oscillating bracket, resulting in the oscillating bracket being tilted at this angle to the vertical, when the bubble is central.

The carriage is therefore provided with the following sighting arrangements :—

Sight operating gear.
No. 7 to 7C, 9 or 10 dial sight carrier, No. 18.
No. 7 to 7C, 9 or 10 dial sight.
Sight clinometer.

SIGHT OPERATING GEAR

The sight operating gear (Fig. 39) is for use with the No. 7 to 7C dial sight carrier, No. 18, and gives elevation and depression to the sight when rocking the cradle about the trunnions by means of the elevating gear.

The gear consists of a sight operating arm, parallel motion link, sight supporting bracket and elevation scale plate bracket.

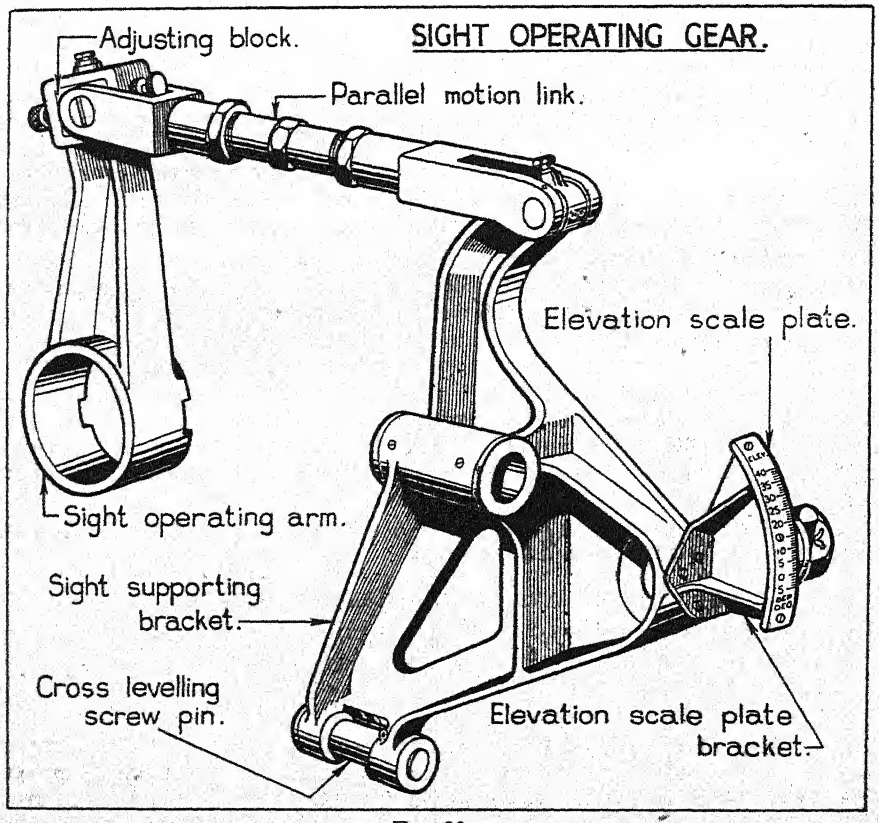


FIG. 39

The **sight operating arm,** of steel, is bored at its lower end for attachment to the trunnion of the cradle, the outer edge having four equally spaced projections which enter recesses in the trunnion to prevent independent rotation. A grub screw is fitted to the left trunnion arm to enable the sight carrier trunnion to be locked in position. Its upper end is in the form of a hollow rectangle which is bored and screw-threaded, front and rear, to receive a hexagon-headed block, adjusting screws and

hexagon lock nuts and spring washers, tommy holes being prepared in each flat of the lock nut, and provided with a tommy, to enable finer adjustments to be made. Its upper surface is prepared to receive a Tecalemit lubricator.

The **parallel motion link** comprises two forked ends, one of which is fitted with a phosphor bronze adjusting block with connecting pin. The block is held in position in the rectangle of the sight operating arm by means of its adjusting screws. The other forked end is secured to the sight supporting bracket by a connecting pin. The forks are bored and screw-threaded to receive an adjusting screw which is threaded with left and right-handed threads, a hexagon being formed about the middle of the screw for the application of a spanner. By rotating the screw, the two forked ends are drawn together, causing the supporting bracket to rotate about its pivot; after adjustment the screw is locked by locking nuts.

The **sight supporting bracket,** of steel, forms the means of attachment of the carrier to the bracket on the saddle and also the means of allowing for cross-levelling the sight.

The lower end of the bracket is bored for a pin to which is secured the inner screw of the cross-levelling gear, the pin being secured by a split pin. About the centre of the bracket on the left side, a projection is formed which is bored longitudinally for a pivot pin for the attachment of the oscillating bracket. The boring is fitted with a phosphor bronze bush which is secured by grub screws. Below the boring at the rear, on the right side, a cylindrical pintle is formed which is the pivot of the bracket; the pintle is screw-threaded for a collar and nut and secured by a split pin. Near the pintle, on the rear edge, are three screw-threaded recesses for the securing screws of the elevation scale plate bracket.

The bracket at the upper end is bored and fitted with a phosphor-bronze bush for the attachment of the forked end of the parallel motion link, the bush being secured by grub screws. A Tecalemit lubricator is fitted at the top of the boring.

The **elevation scale plate bracket,** of aluminium alloy, is a small quadrant-shaped bracket secured to the rear edge of the supporting bracket by three screws and carries a nickel alloy elevation scale plate which is secured by three screws.

Later pattern brackets are a fabricated design of mild steel instead of aluminium alloy or mazac which have proved unsuitable, requiring frequent replacement.

The scale plate is graduated from 5 degrees depression to 40 degrees elevation in divisions of one degree, each 5 degrees being numbered. The letters ELEV. being engraved at the upper end and DEP. DEG. at the lower. The graduations, figures and letters from 0 to 40 degrees are filled in with black paint and the remainder in red.

The plate is read in conjunction with a reader on the bracket on the cradle and was formerly used with the recoil scale strip.

NO. 7 TO 7C, 9 AND 10 DIAL SIGHT CARRIER, NO. 18

The *Mark I* carrier consists of the following principal parts :—

Oscillating bracket.	Adjustable dial sight socket.
Cross-levelling gear.	Range scale gear.
Tangent elevation bracket.	Telescope holder.

The **oscillating bracket** (Fig. 40), of manganese bronze, is pivoted to the supporting bracket and forms the means of correcting the dial sight for verticality, its movement being in the lateral plane. It also forms the pivot of the tangent elevation bracket.

The bracket is roughly in the form of an inverted triangle, the lower point of which is semicircular to bear against the cross-levelling nut, the nut being secured to the bracket by bearing caps, each cap being secured by two screws.

On the right-hand side two projections are formed which are bored longitudinally to receive the cross-levelling hinge pin with its bush, the bush being secured by a grub screw. The pin has a bearing surface at each end for the boring in the bracket, whilst through the centre is a longitudinal boring to the rear end of which is fitted a Tecalemit lubricator. Around each bearing surface is cut a circumferential groove

which has four short longitudinal grooves cut equidistantly at right angles. Where the grooves meet, a hole is drilled through to the interior boring to distribute the lubricant and so lubricate the bearings. The pin is secured by a screwed taper pin passing through one projection and the pin. Towards the top, on the left side, is formed a rectangular projection which carries the adjusting block. One half of the rectangle is composed of an adjusting block cap which is secured by two screws. The projection is bored through its shorter side to take the spigot and nut of the adjusting block. A recess is bored in the centre of the square portion, from left to right, which coincides with a hole in the quadrant case of the tangent elevation bracket and is for use with a tommy for initial setting of the links.

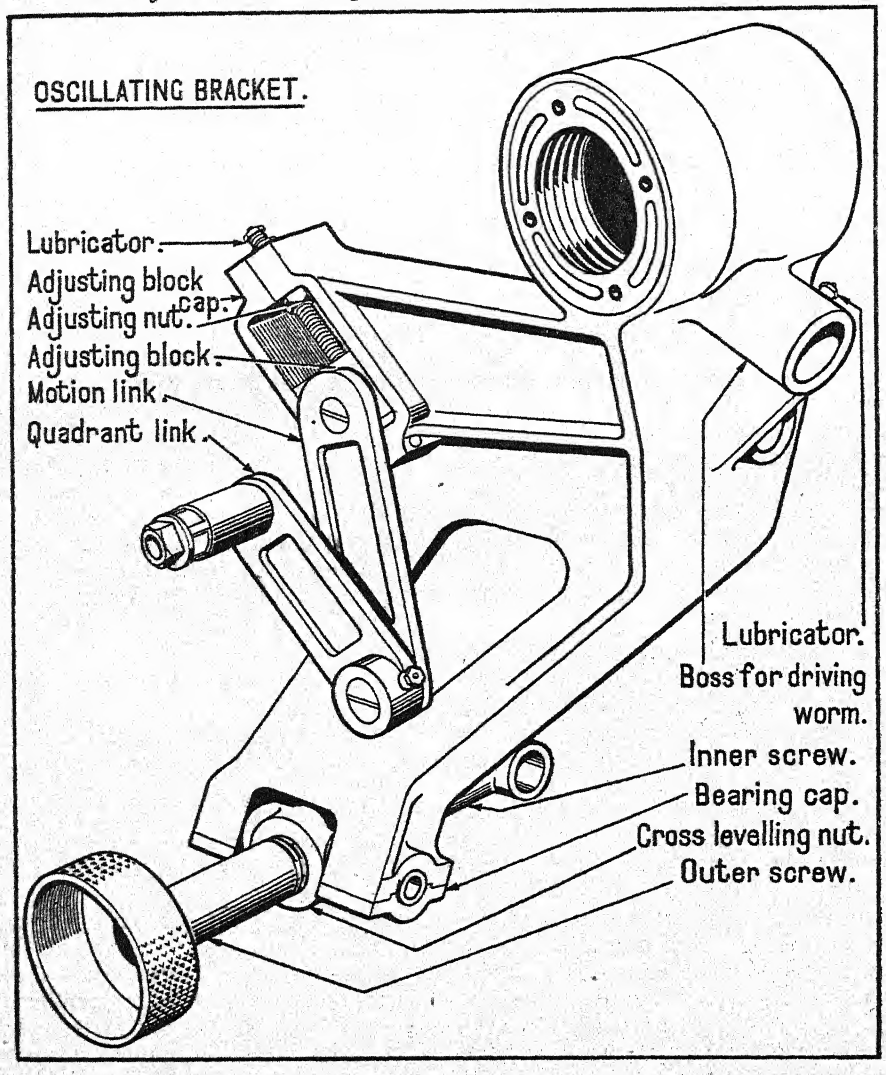


FIG. 40

A boss, formed on the upper surface, is bored in various diameters for the reception of a worm wheel and ball bearings, the boring being screw-threaded at each end to receive an outer screwed ring. An axis spindle which carries the scale plate cone passes through the centre of the boring; it also forms the pivot pin of the tangent elevation bracket on the oscillating bracket. On the rear face is a projection which

is bored longitudinally to receive a driving worm and its screwed bush, the bush being secured by a set screw. The projection is fitted with a Tecalemit lubricator.

The adjusting block (Fig. 40), of steel, is square, having spigots formed on its upper and lower sides, the lower being plain and the upper screw-threaded externally. The spigots are bored centrally. The upper one is fitted with a lubricator. The square portion is bored to receive a steel bush through which passes a pintle of the motion link.

The bush has a groove cut in the interior to distribute the lubricant and is secured to the block by a spigot and grub screw. An adjusting nut is placed over the threads of the upper spigot.

It has a capstan hexagon head and a projecting sleeve. The sleeve passes through a boring on the upper side of the rectangular projection, where it is secured by a cap and also a locking nut, whilst the lower spigot passes through the lower boring.

The motion link (Fig. 40) is a small steel link with a pintle at each end which face in opposite directions. Each pintle is bored and screw-threaded to receive a flanged stud.

One pintle passes through the adjusting block and the other through the quadrant link, where they are secured by the flanged studs, the studs being secured by a grub screw. The flanged stud which secures the link to the adjusting block is bored for the reception of the tommy for the initial setting of the links.

The quadrant link (Fig. 40), of steel, is a small steel link having a boss at its lower end and a pintle at the other. The boss is bored to take a steel bush through which passes the pintle of the motion link. Two screw-threaded holes in the boss diametrically opposite each other, are for a grub screw to secure the bush and a No. 6 Tucker's lubricator respectively. The bush has an oil groove in its interior to distribute the oil. The pintle is reduced in diameter at its outer end and screw-threaded to receive a flanged hexagon nut. In rear of this are formed four equi-distant feathers to engage featherways in the quadrant, which ensure the quadrant and link rotating as one unit, a nut securing the two together. The pintle is recessed from the right, the end being screw-threaded internally to receive a steel bush and Tecalemit lubricator. Two holes are drilled from the exterior of the pintle to the recess to distribute the lubricant. The plain portion of the pintle between the link and the feathers passes through the tangent elevation bracket, thus forming a lever to rotate the bracket.

The **cross-levelling gear** (Fig. 40) is attached to the lower end of the supporting and oscillating brackets and forms the means of rocking the oscillating bracket laterally to correct for drift and difference in level of wheels.

It comprises an inner screw which is attached to the supporting bracket and a nut which is attached to the oscillating bracket, whilst an outer screw operates the assembly.

The inner screw is a steel cylinder with external left-handed screw threads to screw into the outer screw. It has a looped head which passes between the two projections at the lower end of the supporting bracket, where it is secured by a pin and split pin.

The outer screw, of manganese bronze, is cylindrical, with an enlarged milled head for ease of manipulation. The cylindrical portion has external right-hand screw threads for the attachment of the nut and internally left-hand screw threads for the attachment of the inner screw. The internal screw threads are smaller than the plain boring, to form a shoulder up against which fits the head of the stop screw when the two brackets are at their full distance apart, so preventing the two screws from becoming detached.

The cross-levelling nut, of steel, is rectangular and formed with two trunnions for attachment to the lower end of the oscillating bracket. The nut is secured to a bracket by a bearing cap which is secured by four screws. A hole is bored through the rectangular portion of the nut and screw-threaded to pass over the outer screw.

On rotating the outer screw to the front it travels through the nut to the right, at the same time the inner screw screws into the outer screw, the total movement

being to draw the lower end of the oscillating bracket towards the supporting bracket thereby correcting for difference in level of wheels.

The **tangent elevation bracket** (Fig. 41) is the portion of the carrier that gives the vertical movement to the sight to apply tangent elevation and is pivoted to the top of the oscillating bracket. It forms the means of attachment of the adjustable dial

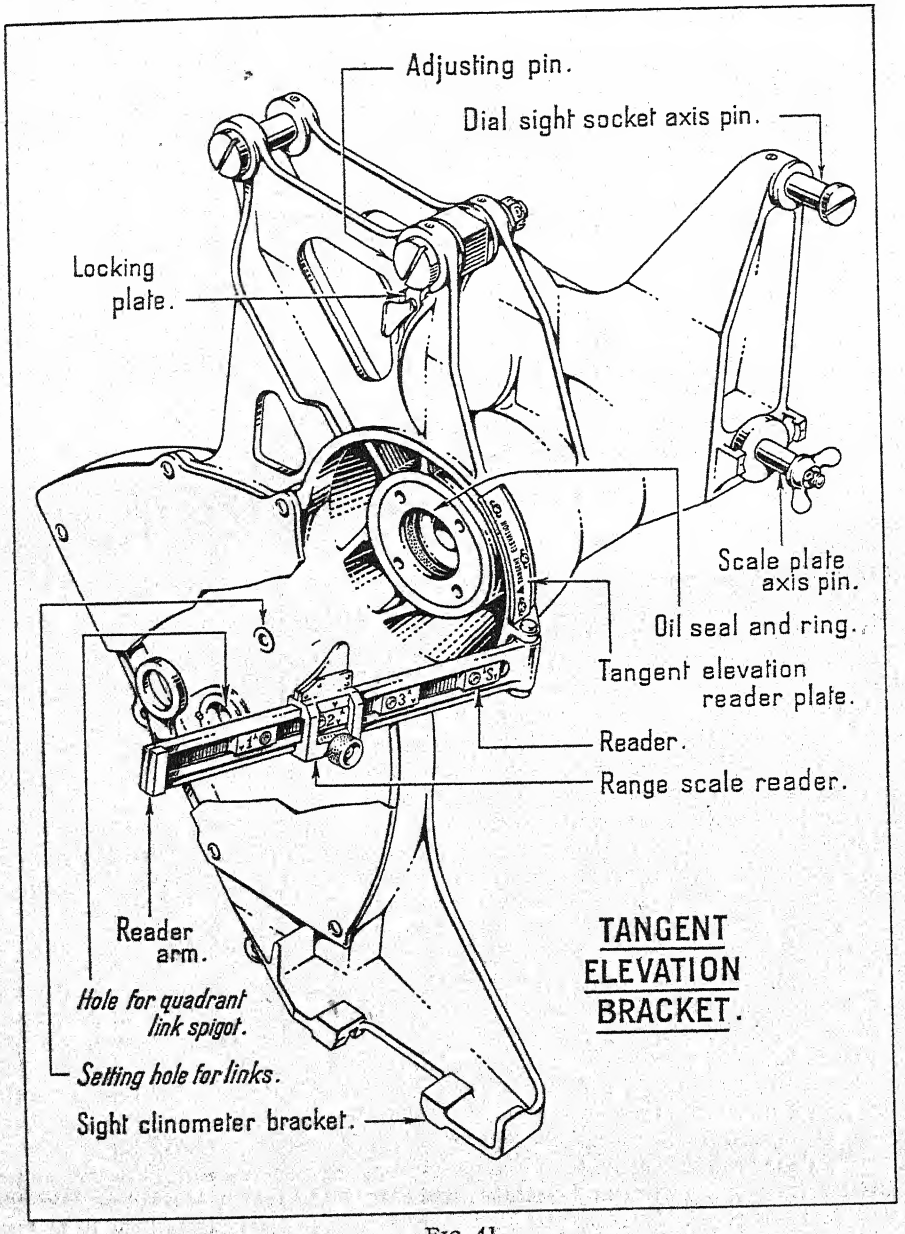


FIG. 41

sight socket, telescope holder and range scale cone and has provision for the attachment of the sight clinometer.

The lower portion is in the form of a semicircular box to contain the quadrant, a hole being bored through the centre of the straight portion to receive the spigot

of the quadrant link ; the hole is fitted with two phosphor bronze bushes to reduce friction. The box is closed by a cover plate which is secured by seven screws, whilst the portion that covers the hole for the nut of the quadrant link has a small projecting cap riveted to it. A projection towards the lower edge of the box portion is shaped to receive a sight or field clinometer, whilst towards the top is a circular recess to take the pinion and the range scale cone. Above the boring for the spigot of the link is a hole which corresponds with a similar hole in the flanged stud of the adjusting block and oscillating bracket so as to position the tangent elevation bracket when a tommy is passed through for the initial setting of the links.

The quadrant, of steel, is contained within the case and forms the medium by which the sight carrier is elevated in the act of applying tangent elevation to the sight. It consists of a quadrant-shaped arc with a series of spur teeth. The lower edge is bored and screw-threaded for the securing screws of a stop plate ; the plate meets a stop screw when the quadrant is at full depression.

To the left of the stop plate the quadrant is bored for the reception of the pintle of the quadrant link, four featherways being cut to engage the feathers on the link.

On the rear face of the circular portion are formed two projections which are bored vertically, to receive the hinge pin of the reader arm, the pin being secured by a keep pin, whilst above these projections is a reader plate secured by three screws. The plate is engraved with an arrow and the words TANGENT ELEVATION, the arrow and words being filled in with black paint or wax. The holes for the screws are elongated ; this allows for a slight vertical adjustment of the plate. Above the reader plate the bracket is formed with two U-shaped projections to carry the telescope holder ; the one at the front is bored for an axis pin and the one at the rear for an eccentric adjusting pin ; below the adjusting pin on the left side is a small recess for a locking plate. The plate and bracket are both bored to receive a set screw.

The projection for the axis pin on the right-hand side is screw-threaded for the pin and bored for a split pin, whilst the rear projection is fitted with phosphor bronze bushes which are secured by grub screws.

The tangent elevation bracket on the right-hand side is formed with an inverted U-shaped projection which forms the pivot for the bracket and is bored and screw-threaded at each end to receive an oil seal screwed ring and a retaining bearing screwed ring respectively, also recesses to take ball bearings. At the inner edges of the U-shaped portion circumferential grooves are cut to distribute the lubricant to the axis spindle which passes through at this point.

Above the U-shaped projection is formed a vertical projection, on the rear face, which is prepared to carry the adjustable dial sight socket and drift scale plate. A hole is bored from front to rear and screw-threaded to receive the dial sight socket axis pin, the pin being secured by a grub screw. Interposed between the boring and the axis pin is a phosphor bronze bush which is secured by a grub screw.

Towards the lower end is another boring which is screw-threaded to receive the drift scale plate axis stud, which is secured by a grub screw. A small projection is formed on each side of the boring, the one on the right is engraved with an arrow and the word CHARGE, whilst the one on the left is engraved with an arrow and the letters DEG, both arrows and letters being filled in with black paint or wax. The arrows are read in conjunction with the drift scale plate. Around the boring for the stud is formed a circular recess to take a phosphor bronze bush.

The latter is flanged to form a bearing for the eccentric of the drift scale plate.

The **drift scale plate** (Fig. 42), of manganese bronze, is a circular plate two inches in diameter, having a projecting boss front and rear. The rear boss is set off from the centre to form an eccentric, whilst a hole is bored through the centre of the front boss to pass over the axis stud. The eccentric boss operates in a hole in the block of the drift plate cam carried in the adjustable dial sight socket and when the plate is rotated the lower end of the socket is pushed to the right or left, about its axis pin, so applying the necessary drift angle to the dial sight. Two adjusting knobs, diametrically opposite, are riveted to the top and bottom of the plate.

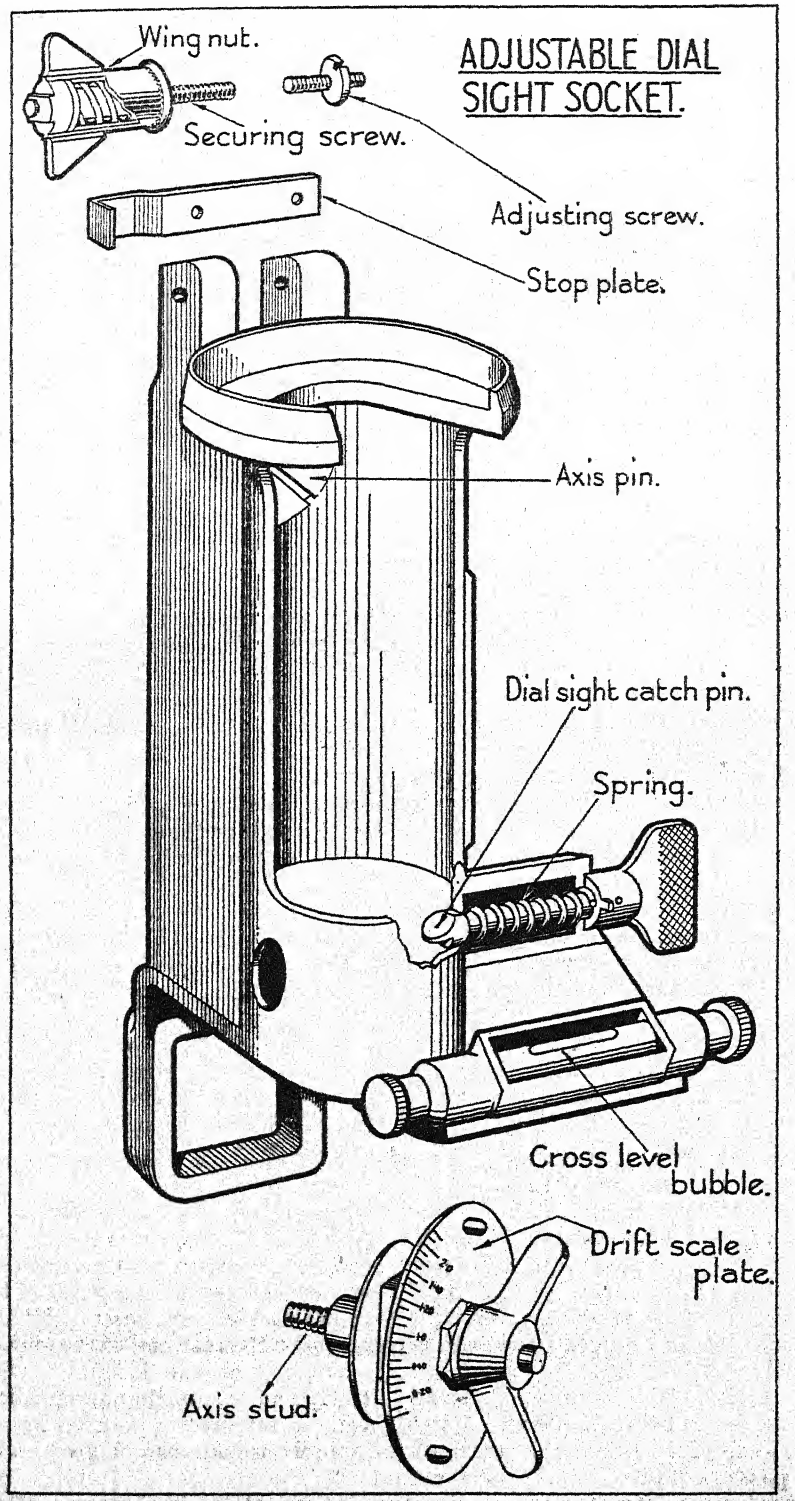

ADJUSTABLE DIAL SIGHT SOCKET.
Wing nut.
Securing screw.
Adjusting screw.
Stop plate.
Axis pin.
Dial sight catch pin.
Spring.
Cross level bubble.
Drift scale plate.
Axis stud.

FIG. 42

The face of the plate is engraved on the left with a set of angles and on the right with two sets of figures 1, 2 and S.3, representing the various charges. The angles are engraved from 5 minutes to 2 degrees 5 minutes in multiples of 5 minutes, each 20 minutes being numbered; the graduations, letter and figures, being filled in with black paint or wax. The plate is secured on the stud by a collar, wing nut and split pin.

The **adjustable dial sight socket** (Fig. 42) is designed to carry the No. 7 to 7C, 9 or 10 dial sight and cross-levelling bubble and forms the medium whereby the sight is adjusted for verticality and allows for the drift correction necessary for various charges and driving bands.

The socket is circular at the top, with a portion cut away at the rear for the insertion of the sight. Two vertical projections are formed at the front between which fits the projection on the body of the sight. They are bored and screw-threaded laterally for the reception of a Mark II dial sight adjusting screw on the right and a No. 2 dial sight securing screw on the left. The adjusting screw is prevented from rotation after adjustment by a lock nut. The securing screw is so designed that too much pressure cannot be exerted when tightening; a slipping device incorporated in the assembly prevents this happening. The screw has a flange formed about its centre on which are cut eighteen ratchet teeth to engage with similar teeth on the wing nut; the latter is hollow and contains a spiral spring, one end of which bears against an internal shoulder in the wing nut and the other against a nut secured in the end of the screw. The nut is flanged, the diameter coinciding with the internal diameter of the wing nut, the nut being secured by a taper pin.

The securing screw is prevented from becoming detached from the dial sight socket by a stop plate secured to the front of the two projections by two screws. The end of the plate is curved inwards to engage over the end of the flange when the screw is fully screwed out. The spring retains the teeth of the screw and wing nut in engagement until excess pressure is used, when the ratchet teeth slip, thus preventing undue stress coming on the screw.

The dial sight axis pin passes through a hole below the circular portion of the socket. At the lower end a rectangular hole is formed for the steel block of the drift plate cam. Above this hole is a projection towards the rear, to form a platform to support the No. 10 cross-level bubble.

The cross-level bubble is a gunmetal carrier in which is fixed an L-glass spirit bubble and an end plug of manganese bronze at each end. The carrier is secured to the dial sight socket by two screws, whilst the plugs are retained by taper pins.

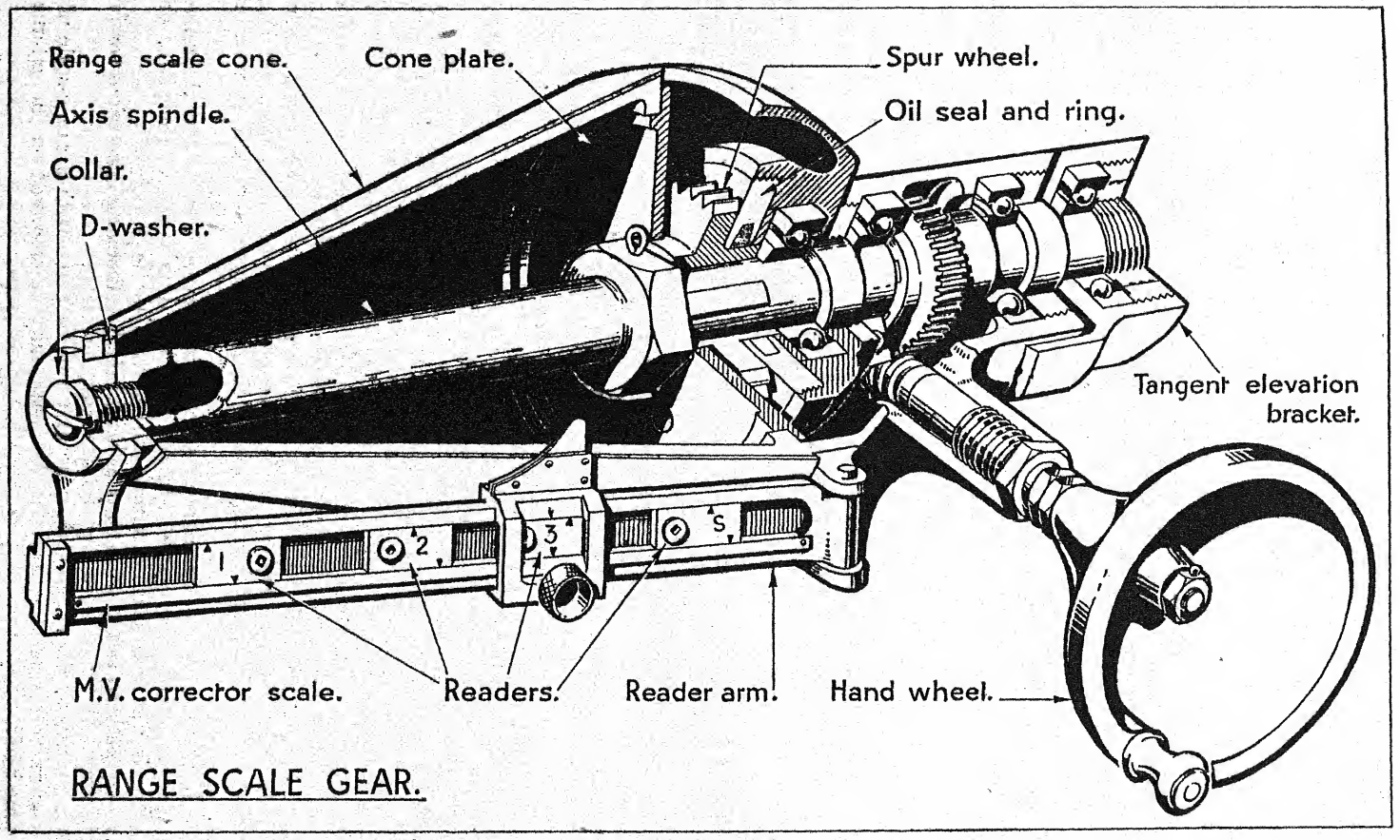
On the right-hand side of the socket is formed a shaped projection which is bored and screw-threaded for the two securing screws of a lampholder bracket.

The lower end of the dial sight is locked to the socket by a dial sight catch pin. The pin is spring-loaded and actuated by a knurled head, the latter being retained by a taper pin. The end of the catch pin is chamfered and the whole assembly is contained within an axial boring in the right-hand side of the dial sight socket.

The **range scale gear** (Fig. 43) comprises a driving worm, axis spindle, range scale cone and M.V. corrector scale.

The driving worm, of steel, is contained within bearings in the oscillating bracket and retained by a manganese bronze bearing bush. The worm is in the form of a spindle, having a worm thread at its front end to engage with the worm wheel on the axis spindle, whilst just in rear is formed a flange. The worm is assembled from the inside of the oscillating bracket, the flange preventing the worm passing right through the boring. After assembly, the bush is passed over the rear end of the spindle from the outside and retained in position by a flanged nut and locknut. The worm spindle at the rear is hexagonal for the attachment of an aluminium alloy hand wheel, the latter being fitted with a steel bush and retained in position by a slotted nut and keep pin. About the centre of the spindle are cut two oil grooves to allow for the passage of oil.

Certain worm spindles have a locating spigot which is accommodated in an



RANGE SCALE GEAR.

FIG. 43

additional boss on the worm spindle bracket, thus giving a greater bearing area to the spindle.

The axis spindle is contained within bearings in the oscillating and tangent elevation brackets and carries the range scale cone and plate, spur wheel and worm wheel and, in addition, various journal ball bearings.

The spindle is cylindrical being reduced in diameter at the left-hand end and screw-threaded to receive the collar securing screw. It is further screw-threaded externally about the centre for the inner nut, which is secured by a keep pin. To the right of these screw threads the diameter is increased slightly and formed with four longitudinal feathers to suit the featherways of the spur wheel. The diameter is further increased to the right of the spur wheel and formed with four longitudinal feathers to receive the worm wheel. Midway between these two sets of feathers the spindle passes out of the left-hand side of the oscillating bracket and into the tangent elevation bracket, therefore at this position two sets of deep groove ball journal bearings are placed, one on each side of a distance piece.

A flange is formed on the spindle to the right of the feathers for the worm wheel which acts as a dividing collar for two sets of Hoffman's deep groove extra light ball journal bearings. The right-hand end of the spindle is screw-threaded to receive an outer nut by which it is secured to the tangent elevation bracket.

The worm wheel and its ball journals are secured in position in the oscillating bracket by an outer screwed ring on the left and a retaining bearing screwed ring on the right. Both of these rings are prevented from rotation by a grub screw, whilst their internal circumferences have grooves cut for lubrication purposes.

The right-hand ball journal of the tangent elevation bracket is retained by a retaining bearing screwed ring and an oil seal screwed ring retains the left-hand bearing, both rings being secured against rotation by grub screws. The oil seal screwed ring has a circumferential groove cut in its interior into which fits an oil seal of hard felt.

A brass dust excluder is secured to the retaining bearing screwed ring by four screws. The excluder prevents dust, etc., entering the interior of the moving parts of the spindle.

A cone plate, which forms a bearing surface for the cone, is secured to the left-hand face of the spur wheel by four screws and the cone is retained on the spindle by a D-washer, collar and securing screw. Enough pressure is placed on the cone by the screw to make the plate and cone rotate with the spindle.

The **range scale cone** is a conical aluminium alloy fitment which carries the range scale plate; two dowel pins are riveted to the cone to position the plate.

The plate, of zinc sheet, is shaped to fit the cone and is engraved with a scale around its base representing degrees of tangent elevation from 0 to 45 degrees in multiples of 10 minutes, each degree being numbered. Existing carriers will have the range scale cone engraved locally with additional lines for A/T purposes. In addition to the tangent elevation scale there are four other scales engraved in yards for charge one, two, three and super charge. Charge one is engraved from 100 to 4,500 yards, charge two from 200 to 8,400 yards, charge three from 500 to 12,500 yards and super charge from 10,500 to 14,000 yards. All tens and multiples of ten, lines and figures, are filled in with red paint, whilst all other lines and figures are filled in with black paint.

Each of the charges are marked with their relevant charge and the range is indicated as hundreds of yards. In addition, the designation of the plate, Mark, contractor's initials and year of supply are engraved on the plate.

A new pattern range scale cone is being fitted embodying corrections for jump and having additional engravings for anti-tank shooting.

Alternatively, the range-scale cone may not be fitted with a range-scale plate, but the markings, as described for the plate, may be engraved on the exterior of the cone itself.

The graduations are read in conjunction with a reader, which slides along a reader arm.

The reader arm, of steel, has a boss at one end which is bored vertically to receive the hinge pin by which it is attached to the tangent elevation bracket. At the other end is attached a supporting bracket which is bored to pass over the end of the axis spindle of the cone. The rear face of the arm is formed with an undercut longitudinal recess in which fit and slide the M.V. corrector scale readers. The lower edge is shaped to fit the range scale reader, whilst at the left-hand end is a stop-piece secured by two screws to prevent the readers from becoming detached.

The **M.V. corrector scale strip,** of nickel alloy, is attached to the reader arm by three screws. It is engraved with four M.V. scales to coincide with the M.V. corrector scale readers, one for charge one, engraved from 500 to 700 f.s. with an arrow at 650 f.s. to indicate normal M.V.; one for charge two, engraved from 830 to 1,020 f.s. with the arrow indicating 975 f.s. normal; one for charge three, engraved from 1,350 to 1,550 f.s. with the arrow indicating 1,450 f.s. normal and one for super charge, engraved from 1,600 to 1,800 f.s. with the arrow indicating 1,700 f.s. normal. The graduations are equally spaced at 10 f.s. apart for each particular charge, whilst the holes for the securing screws are elongated to allow for slight lateral movement. All lines, figures and letters are filled in with black wax, the arrows being filled in with red wax.

The **M.V. corrector scale readers** are formed with a flange at the top and bottom to slide in the undercut groove in the reader arm and are bored and screw-threaded for a clamping screw. The rear face is engraved with its appropriate charge 1, 2, 3 or S and an upper and lower arrow, all engravings being filled in with black paint or wax. The heads of the clamping screws are formed with a square recess for the application of a key.

The **range scale reader** is shaped to slide along the reader arm and is provided with a clamping screw which has a knurled head for ease of manipulation. A square hole is cut in the front face to enable the M.V. readers to be observed, whilst at the top of the square is engraved an arrow to read in conjunction with the upper arrow on the M.V. scale readers, the arrow being filled in with white paint or wax. Two holes are bored and screw-threaded for the reception of a lamp-holder, in the upper surface.

A clicking device is provided, to position the readers for blind setting, consisting of a flat spring attached to the range scale reader engaging in a small V-shaped recess in each M.V. corrector scale reader.

An index piece, of celastoid, is riveted to the top of the reader; it is engraved with a circular spot on its under side, the spot being filled in with black wax.

A range scale reader of simplified design has been fitted to certain carriers.

The **telescope holder** is hinged to the top of the tangent elevation bracket and is shaped to hold the No. 29 sighting telescope. It is fitted with open sights for rough laying and can be adjusted for collimation by an eccentric pin. The open sights cannot be used whilst the telescope is in position as the insertion of the telescope or the adapter for the No. 22C sighting telescope, in the holder defunctions the fore sight and necessitates moving the hind sight to the right.

The holder, of aluminium alloy, is cylindrical in section to hold the telescope, having two projections on each side at the front end, to which is hinged the telescope holder cap.

In rear of the cap a locking catch, consisting of a plate containing a wing screw, is secured to the under side of the holder by two screws. The locking catch serves to secure the adapter for the No. 22C sighting telescope in the telescope holder when that telescope is being used as an alternative to the No. 29. A small projection is formed at the rear end on the under side, which is bored for the hind sight supporting bracket. On the upper surface are two projections, the one at the front for an axis pin and its phosphor bronze bush, whilst the one in rear is formed with a rectangular hole for the manganese bronze adjusting block, the bush for the axis pin being secured by a grub screw. A longitudinal featherway is cut internally on the lower surface to engage the feather on the body of the No. 29 telescope, or the key on the adapter

for the No. 22C telescope, thus ensuring that the graticules of the telescope will be in the vertical and horizontal plane.

The hind sight is a small plate having a U-shaped slot with a strip of white paint the same width and in prolongation to the slot. It is attached to the supporting bracket by two screws, the holes for the screws being elongated to allow for slight lateral adjustment.

The supporting bracket is hinged to the projection on the rear of the holder by a pin with a spiral spring interposed between the head of the hinge pin and the projection on the holder. By pulling the hind sight to the rear against the spring the supporting bracket is free to revolve away from the opening in the holder for the telescope.

The telescope holder cap is hinged to the right side projections on the holder and secured after the insertion of the telescope, by a milled clamping nut which is secured to a screw hinged to the left side projection of the holder.

The cap is U-shaped, one end being shaped for a hinge pin and the other forked to receive the screw of the holder. A boss is formed in the centre which is bored for the reception of the fore sight and its spring.

The fore sight has a hexagonal, cone shaped head above a screw-threaded spindle portion. The spindle fits in a recess in the projection of the cap and is secured by a knurled nut, the latter being retained by riveting over the end of the spindle. A spiral spring is interposed between the head of the spindle and an interior shoulder. The fore sight is defunctioned by the insertion of the telescope.

Adjustment in the vertical plane is accomplished by the block, at the rear end of the holder, being attached to the tangent elevation bracket by an eccentric pin, the shank of which is formed eccentric where it bears in the block. The head of the pin is flanged and around its periphery are formed serrations into which fits a locking plate, the latter being retained by a set screw. The hole in the plate is elongated so that it is not necessary to disengage the screw to release the locking plate from the serrations in the flange of the eccentric pin.

Action

By rotating the hand wheel of the range scale gear in a clockwise direction the worm wheel is rotated by the worm. The worm wheel rotates the axis spindle and with it the spur wheel and cone until the necessary range is read against the dot on the celastoid index piece of the range scale reader, according to the charge employed. At the same time, the spur wheel engaging with the teeth of the quadrant rotates it in an upward direction, taking with it the quadrant link.

The quadrant link endeavours to push the motion link up against the adjusting block, but as the latter is stationary the force of rotation causes the spigot of the quadrant link to act as a lever and pivot the tangent elevation bracket about the axis spindle causing the whole of the sight carrier to assume a forward tilt equal in amount to the tangent elevation. This movement of the carrier as a whole is in the ratio of 1 to 2 to the movement of the cone.

To place the gun at the tangent elevation due to the range shown on the cone, the elevating gear is now operated until the bubble of the sight clinometer or field clinometer is in the centre of its run. The elevation applied will be tangent elevation, or quadrant elevation dependant upon whether the sight clinometer is set at zero or to the appropriate angle of sight.

Drift is allowed for by setting the drift scale plate at the charge employed, when the cam, acting in its recess at the lower end of the dial socket, forces the bottom of the socket, and with it the dial sight to the left or right. When the cross-levelling bubble is brought central by its gear, it will be observed that the sight is off the aiming point, therefore it is necessary to bring it on again by the traversing gear and the correction for drift is thus applied.

The *Mark IA* carrier is generally similar to the *Mark I* but has a different design of tangent elevation bracket to which is attached a supporting bracket for the No. 1

Mark I No. 22C sighting telescope adapter. The carrier is also provided with an open sight having a deflection scale.

The **telescope adapter supporting bracket** is of malleable cast iron. It is positioned by a steel dowel and is secured by four screws to the tangent elevation bracket in a position to the rear of the bracket for the fore sight.

The supporting bracket contains a spring-loaded steel plunger, operated by a steel release lever which projects to the rear and is secured to the spindle of the plunger by a nut.

Under the action of the spring the top of the plunger engages in a recess in the key of the telescope adapter thus retaining the latter in its correct relative position when the No. 22C telescope is in use.

When it becomes necessary to use the No. 29 sighting telescope the lever is depressed thus releasing the adapter and permitting its removal.

The upper portion of the bracket is in the form of a ring which is dimensioned internally to suit the No. 29 sighting telescope or the forward end of the main tube of the telescope adapter when the No. 22C sighting telescope is being used. An internal keyway, at the bottom of the ring, accommodates the key on the exterior of the adapter, which ensures that the adapter is correctly positioned in the bracket.

The **open sight** consists principally of a fore sight and a hind sight, each with brackets, a deflection screw, a deflection nut and a scale plate and reader.

The **fore sight,** of steel, is in the form of an elongated cone surmounted by a ball. It is so mounted that it may be lowered to the front, when a sighting telescope is being used, in order not to obstruct the line of sight.

The **fore-sight bracket,** of malleable cast iron, is attached to the tangent elevation bracket in front of the supporting bracket for the telescope adapter, in a position that permits the ball of the fore sight being brought coincident with the centre line through the telescope holder.

The bracket is positioned by a dowel and secured by three screws. The screw-threaded lower end of a steel fore sight pivot is located in a vertical hole through the outer end of the bracket, where it is retained in the correct position by means of a lower and an upper lock nut. A flat-ended screw, which bears against a plain surface prepared on the screw-threaded portion, prevents the pivot from turning in the hole through the bracket, but permits it to slide freely, thus facilitating the vertical adjustment of the fore sight by operating the lock nuts.

Above the screw-threaded portion the pivot is enlarged and provided with a recess for a spring-loaded steel plunger. Above the recess the pivot is in the form of two lugs, each of which is drilled to suit a steel pivot pin on which the fore sight is pivoted between the lugs. The pivot pin is retained in position by a split keep pin. The clearances between the lugs permits the fore sight to be turned down when not in use and the spring plunger, bearing on its lower portion, causes it to be retained in the selected position.

The **hind sight** is a rectangular frame, containing cross wires, which is attached to the deflection nut through the medium of the hind sight supporting bracket. Like the fore sight, it can be turned down when not is use.

The **hind-sight bracket,** of malleable cast iron, is attached to the rear of the tangent elevation bracket where it is positioned by two dowels and secured by four screws. The rear upper portion of the bracket is prepared to take the deflection screw and nut, each end of the prepared portion being bored and bushed with phosphor bronze to suit the turned diameters at the ends of the screw, whilst the centre is proportioned to suit the dimensions of the deflection nut.

A deflection scale plate, of nickel alloy, is secured to the rear of the bracket by two screws. The scale permits a maximum deflection of two degrees on either side of centre, the plate being graduated in degrees and engraved R and L. Projections are formed at each end of the rear portion of the bracket to act as stops to limit the travel of the deflection nut.

The **deflection screw,** of steel, is located in the hind sight bracket and is screw-threaded for a portion of its length to suit the threads in the deflection nut. A knurled deflection screw head is fitted around a square portion of the outer end of the screw and is secured in position by means of a nut and spring washer.

The inner end of the screw is provided with a D-washer of steel, which revolves with the screw, and the whole assembly is secured in its bearings by means of a nut and spring washer fitted outside the D-washer.

The **deflection nut,** of phosphor bronze, is screw-threaded internally to suit the deflection screw and is so fitted that it slides easily along the prepared portion of the hind sight bracket, without rocking. Two lugs are formed on the upper surface of the nut, each of which is drilled to suit the steel hinge pin on which the hind sight supporting bracket is pivoted. The ends of the hinge pin are riveted over to secure the bracket, whilst the hind sight is attached to the bracket by means of two screws.

A steel plate type spring is located, and secured by two screws, in the space between the lugs of the deflection nut, where a sloping surface is prepared to afford a clearance for the movement of the hind sight supporting bracket when the hind sight is in the process of being raised or lowered. The spring serves to retain the hind sight in the desired position.

A reader plate, of nickel alloy which works in conjunction with the deflection scale plate, is secured to the rear of the deflection nut by two screws and thus traverses with it.

The screw holes in the plate are elongated to facilitate setting up and adjustment.

ADAPTER, NO. 22C SIGHTING TELESCOPE, NO. 1

The *Mark I* adapter consists principally of a tube and a bracket. It is inserted from the rear into the telescope holder of the sight carrier when the No. 22C sighting telescope is being used in lieu of the No. 29. The telescope is inserted into the adapter from the front and is secured in position by a locking nut.

The tube portion of the adapter consists of a main tube and two end pieces.

The **main tube,** of steel, is the same dimensions throughout. A keyed end piece is welded to the forward end and a screw-threaded end piece to the other.

The **keyed end piece,** of steel, is tubular and is welded to the object glass end of the adapter main tube. The front portion of the end piece is the same external dimensions as the No. 29 telescope and fits inside the front ring of the telescope holder, or telescope adapter supporting bracket. In rear of this, the exterior is reduced in diameter and a key is secured by two screws to the bottom, the front portion of the key, which is chamfered, fitting into a slot cut in the front bearing surface. A circular recess is provided in the lower surface of the key to receive a locking plunger which retains the adapter in its correct relative position. Internally the end piece is reduced in diameter to form a stop for the collar on the exterior of the No. 22C sighting telescope and the bottom of this portion is slotted to provide a clearance for the key on the collar which ensures that the telescope will be properly positioned in the adapter and also prevents it from turning. In rear of this, the end piece is still further reduced in diameter both externally and internally to suit the main tube of the adapter and the front bearing surface of the telescope respectively.

The **screwed end piece,** of steel, which is also tubular, is welded to the eyepiece end of the main tube of the adapter. The interior is the same dimension throughout to suit the rear bearing surface of the telescope. Externally the forward portion of the end piece is reduced in diameter to fit into the main tube and a little in rear of this, flats are formed on the top surface and on each side. Still further in rear, the end piece is screw-threaded externally to suit the telescope locking nut, and the extremity of the end piece is chamfered to suit a similar chamfered portion inside the nut.

Four equidistant saw-cuts are cut lengthwise through the chamfered and screw-threaded portions in order that the locking nut may exert pressure through the end piece to retain the telescope in the adapter.

The **bracket** is of manganese bronze. The front portion is cylindrical and, being of the same external diameter as the No. 29 sighting telescope, fits into the rear telescope holder on the tangent elevation bracket of the sight carrier.

By means of an adapter positioning stud, an adjusting plunger and two adjusting screws, the bracket is attached to the screwed end piece in such a manner as to permit of both lateral and vertical adjustment. An upper external boss is formed on the bracket, in rear of the portion that fits into the telescope holder, and the stud is screwed into this boss until a rounded surface, at the bottom of the stud, is in contact with the top flat on the end piece. Above the rounded surface the stud is increased in diameter and screw-threaded for a portion of its length to suit the threads in the boss. Above the screw-threaded portion is a flange above which the stud merges into a reduced diameter, which fits the interior of an identification sleeve, and the remaining upper portion of the stud is in the form of a square with the corners removed to fit a hole of similar shape in a knurled knob. The centre of the top surface of the stud is drilled and screw-threaded to receive the sleeve securing screw, the enlarged head of which fits into a recess in the top of the knob.

The exterior of the sleeve is machined in two diameters. The lower portion, which has the larger diameter, has four grooves cut vertically in its outer surface whilst the upper portion has the figures 0, 3, 7 and 9, representing hundreds of yards, engraved upon it immediately above the grooves to which they refer. For the purpose of identification " 25-PR. MK. I " is engraved midway between the figures 3 and 7. All letters and figures are filled in with red wax or paint.

The sleeve is clamped between the flange on the stud and the lower face of the knob by the pressure exerted by the sleeve securing screw, thus avoiding independent movement. The sleeve is provided with a stop screw which, in conjunction with the upper projection on the bracket, limits the movement of the knob and ensures that it is turned in the correct direction when range settings are applied.

The knob, of steel, which is knurled around its outer circumference, fits around the square portion of the stud above the sleeve and is secured to it by means of the sleeve securing screw which screws into a prepared hole in the top surface of the stud with its enlarged head situated in a recess in the knob. An upper rear projection on the bracket has a hole containing a spring-loaded knob locking plunger, the head of which is designed to engage in the grooves of the sleeve. The end of the plunger spindle protrudes to the rear and is flattened outside the bracket to prevent removal of the plunger.

A lower projection, formed on the bracket immediately below the position of the stud, contains a spring-loaded adjusting plunger, the head of which bears constantly against the rounded lower surface of the screwed end piece. The end of the plunger spindle, which protrudes through the bottom of the projection, is screw-threaded to take a nut and, after assembly, the spindle is lightly riveted over the nut to prevent removal of the plunger.

The interior of the bracket, in rear of the portion that fits into the telescope holder, is reduced in diameter and provided with a flat at the bottom and also one on each side. This portion of the bracket has a tapped hole in each side to take adjusting screws, each of which is provided with a locking nut. The screws protrude through the flattened portion of the bracket and bear against the flats on the sides of the screwed end piece. The telescope in the adapter can be adjusted for line by manipulating the screws.

Range settings are applied by operating the knob which, as the range setting is increased, causes the lower surface of the stud to be withdrawn from the top flat of the end piece whilst, at the same time, the head of the adjusting plunger, under the action of its spring, continues to bear constantly against the bottom surface of the end piece and thus retains the telescope at the angle appropriate to the selected range. Conversely, as the range setting is decreased the stud bears down on the end piece against the continuous pressure of the adjusting plunger. The identification sleeve, being clamped between the knob and the flange on the stud, turns with the knob, and the knob locking plunger is forced out of the groove in which it is situated.

When the setting has been completed the plunger engages in the groove below the figure indicating the selected range, thus locking the knob against accidental movement and giving audible indication of the range setting applied to the sight.

DIAL SIGHTS

The **Mark I No. 9 dial sight** (Fig. 44) is designed to replace the No. 7A to 7C dial sights, and to overcome difficulties in manufacture of the former patterns. It is in effect two complete telescopes placed end to end, and is manufactured in three separate units, the head sighting, azimuth gear and supporting pillar. They are made to exact dimensions so as to be completely interchangeable between sights of the same pattern. It is only necessary, in the event of damage, to fit a new assembly to recondition the sight. It is completely watertight throughout and two screws (desiccating screws) are provided to extract moisture from the interior. These screws must not be touched by any but a qualified artificer.

The dial sight consists of two main sets of components, the mechanical and the optical arrangements, none of which may be tampered with except by a qualified artificer.

The mechanical arrangements provide for the retention of the eyepiece in a fixed position in the carrier, while the upper portion of the sight, which carries the reflector, upper prism, diaphragm, erector and object glass is capable of horizontal movement through 360 degrees by means of worm gearing, the angular movement being recorded in divisions of 10 minutes. The worm can be thrown out of gear to permit rapid setting of the sight.

To provide for the target or aiming point not being in the same horizontal plane as the carriage, a reflector is provided which is capable of a limited angular movement in the vertical plane, while a small open sight is provided to facilitate the operation of picking up the point to be layed upon.

The optical arrangements consist of a series of prisms and lenses, which combine to produce an erect image of the object, as viewed from the eyepiece, combined with a magnification of 4 diameters and a field of view of 10 degrees.

An electrical arrangement consisting of a fixed terminal, a slip ring and brush and a moving terminal is provided, in order to allow for illumination of the diaphragm without danger of twisting of the leads when rotating the dial plate.

The dial sight (Fig. 44) consists mainly of the following main mechanical assemblies :—

Supporting pillar
Azimuth gear
Sighting head.

The **supporting pillar** consists of a pillar, eyepiece adapter, eyepiece cell, prism mount, erector cell and centre prism holder.

The **pillar** provides the means of attaching the sight to the carrier and contains the lower optical arrangements. It consists of a steel tube screw-threaded externally, at its upper end, to receive a flange, and internally, at its lower end, for a plug and stud. In addition to the screw threads the flange is secured to the tube by welding. Just above this screw thread a hole is prepared in the side of the tube and screw-threaded to receive a steel tube to contain the eyepiece. The eyepiece tube is screw-threaded internally for the prism seating ring, and the eyepiece adapter secured by two set screws. A bronze screw-threaded bush is sweated into the pillar at this position to receive the erector cell.

The flange is screwed and welded to the upper end of the pillar and is prepared on its under side with a circumferential coned seating to fit over the top of the dial sight socket. Its periphery is prepared with seven holes for the securing screws which secure the casing to it, and an additional hole for a steady pin. A portion of the flange is cut away on each side of one of these holes leaving a rectangular projection to form a bearing surface for the adjusting screws of the dial sight socket for alignment purposes, the cut-away portions allowing clearance for the adjusting screws. Towards

Nº 9 DIAL SIGHT.

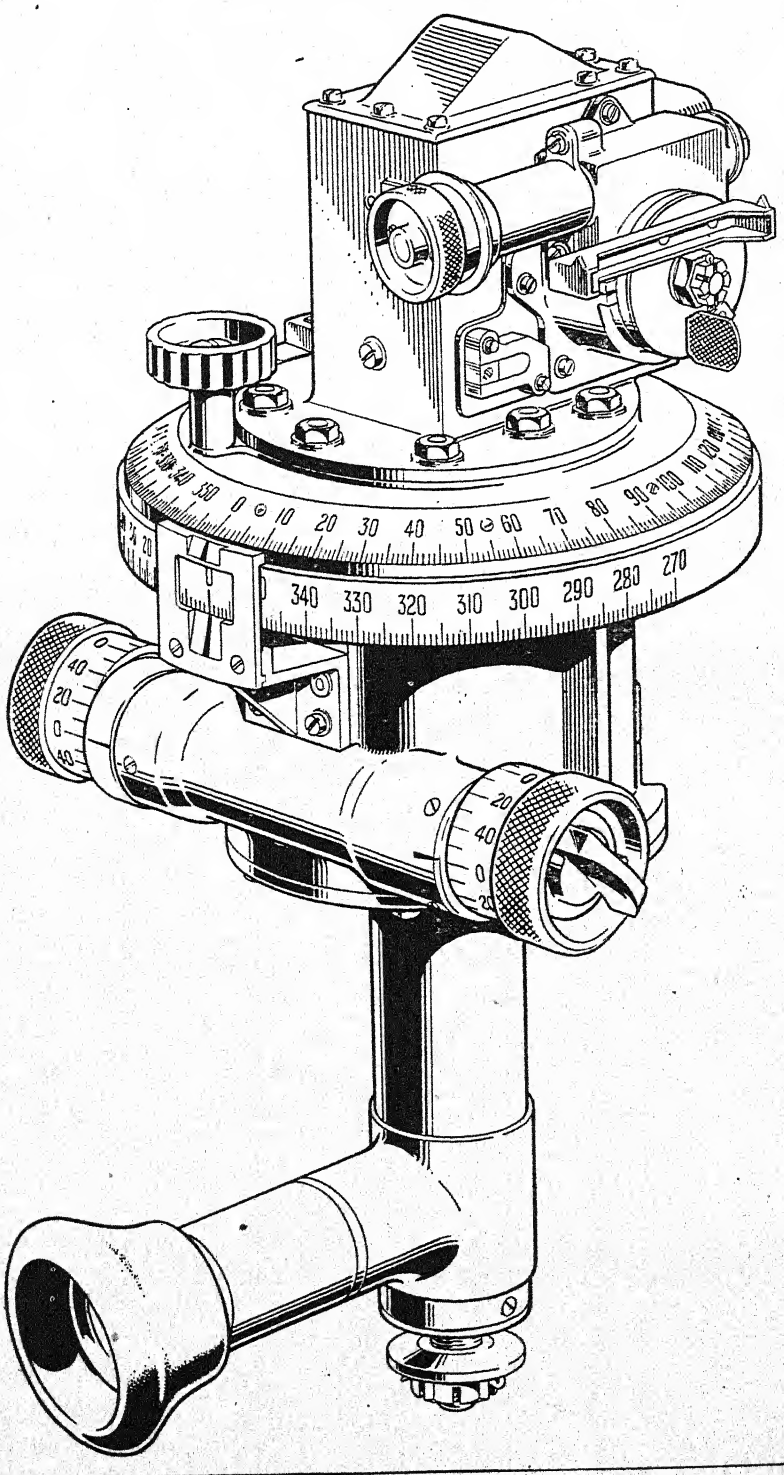


FIG. 44

the centre five elongated holes are prepared through the flange to enable the lower bevel wheel to be secured to it and to permit a slight rotary movement of the wheel for initial adjustment.

The interior of the pillar is prepared to house the centre prism holder, erector cell, lower prism mount and eyepiece seating tube.

The lower end of the pillar is closed by a plug, below which a stud is screwed in having a projecting screw with a slotted nut which can be adjusted to engage the catch of the dial sight socket to secure the sight in the socket and prevent it lifting.

The **eyepiece adapter,** of steel, is screw-threaded externally at one end to screw into the eyepiece tube against a mild steel ring, the other end being screw-threaded internally for the reception of the eyepiece cell. A tapped hole is provided in the under side for a desiccating screw which is painted red.

The **eyepiece cell,** of brass, is screw-threaded externally for attachment to the adapter and prepared with a flange for the attachment of the No. 8 detachable rubber eyeguard. It is prepared internally to receive the eyepiece lenses with their distance ring and counter cell.

The **prism mount,** of aluminium alloy, is shaped around its outer surface to fit into the lower end of the pillar where it is retained by the plug. It is hollowed out to fit the prism which it supports, cork or velumoid packing being interposed between the prism and mount to prevent damage to the prism. A brass prism ring screws into the eyepiece tube to support the side face of the prism, thus holding the prism firmly between the ring and mount.

The **erector cell,** of brass, contains the erector lens and screws into the brass bush at the lower end of the pillar where it is secured by a set screw.

The **centre prism holder,** of gunmetal or manganese bronze, is cylindrical in shape having a flange at its upper end to form a bearing against the upper surface of the lower bevel wheel, a shim or washer being interposed. Below the flange the exterior is machined to fit accurately in the supporting pillar in which it rotates. Above the flange a projection is formed to provide an axis for a 24 teeth bevel pinion, the pinion being secured by a securing screw. The teeth of the pinion are in mesh simultaneously with a 64 teeth upper bevel wheel secured to the worm wheel and a similar wheel secured to the supporting pillar.

The interior of the holder is prepared to receive the centre prism mount with its distance tube and securing ring.

The mount is circular in section to fit the holder and is provided with a flange on the outside to form a stop or bearing against the interior of the holder and for the distance tube to bear against. Internally a square hole is provided to receive the prism, which is secured in the mount by a brass segment and a securing screw. The mount is secured to the holder by a grub screw.

The **azimuth gear** consists principally of a worm wheel, upper bevel wheel, casing, illumination terminal, reader bracket with reader, dial plate and worm gear.

The **worm wheel,** of gunmetal, is machined externally to form a bearing surface within the casing, in which it is housed. Around the lower end are cut 72 hobbed teeth to gear with the worm, each tooth representing 5 degrees. At its upper end two steps are formed, the upper of which is prepared with tapped holes to secure it to the dial plate. Internally, it is bored centrally to receive the spigot of the sighting head, two flanges being prepared with screw threads, the upper to receive the spigot of the sighting head and the lower for the upper bevel wheel.

The **upper bevel wheel,** of mild steel, has 64 bevel teeth which mesh with the bevel pinion, causing the pinion to rotate over the lower bevel wheel. The bevel pinion, being attached to the centre prism holder rotates the holder at half the speed of the upper bevel wheel and its attachments. This method of gearing ensures that an erect image is viewed at all times. It is provided with a screw-threaded spigot for attachment to the worm wheel and prevented from independent rotation by a grub screw. Two tommy holes are provided for insertion and removal.

The **casing,** of aluminium bronze, is mounted on the flange of the supporting pillar to which it is secured by seven screws. It is machined internally to receive the worm wheel which rotates in it.

Externally a boss is formed which is bored to house the worm gear, whilst above this boss a surface is prepared to accommodate a bracket to carry the reader plate. Diametrically opposite this boss a rectangular projection is prepared for the adjusting screws of the dial sight socket, above which a surface is prepared to receive the illumination terminal. Engraved on the outside are the words THIS SIGHT MUST BE KEPT IN CASE WHEN NOT IN USE.

The upper end of the exterior of the casing has a circumferential shoulder around which fits a bakelite insulator and brass slip ring, secured by two screws.

The **illumination terminal** is secured to the casing by three screws and conveys the current from a battery to the slip ring where it is picked up by a brush secured to the dial plate. It consists of a brass base, screw-threaded externally for a cable gland and bored internally for a bush of insulating material through which passes a brass plug. Soldered to the plug is a short length of cable, its other end being soldered to the slip ring. The brass base is earthed to the casing.

The **reader bracket with reader,** is a small cranked brass fitment secured to the casing to carry the reader. Two elongated holes are provided in the upper edge for the screws which secure the reader to the bracket, for adjustment purposes.

The reader plate, of brass, is secured to the bracket by two screws which pass through the bracket and into a securing plate at the back, and is rectangular in shape with an oblong hole in the centre to view the graduations of the slipping skin.

It is provided with two arrows, the upper one for the scale on the dial plate, and the lower for the scale on the skin. The upper reader is filled in white and the lower in black.

The **dial plate,** of aluminium alloy, is secured to the worm wheel by six screws, each having a "Shakeproof" washer. Externally, it is provided with two brass graduated rings, one the scale ring and the other the slipping skin.

The scale ring is secured to the dial plate by nine screws, with a guide ring interposed, and is engraved with an anti-clockwise scale of 360 degrees, each 10 degrees being numbered. All lines and figures are filled in white on a matt background.

The slipping skin fits around the periphery of the dial plate and is engraved with a clockwise scale of 360 degrees, each 10 degrees being numbered. All lines and figures are filled in black on a grained and lacquered background. The skin is clamped, when required, by a clamping screw with plate and knurled head.

Clearances are cut in the under surface of the dial plate to fit the upper surface of the worm wheel and casing, a circumferential recess being cut to receive a felt ring, a similar ring being interposed between the upper end of the casing and the dial plate, to exclude moisture. Secured to the under surface of the plate is a bakelite contact brush bracket, the bracket being fitted with a nickel silver spring brush to make contact with the slip ring as the dial plate rotates. As the current is collected from the slip ring by the brush it is conveyed to a bakelite terminal block on the upper surface of the dial plate by a cable, the end of which is soldered to the terminal on the block.

A **worm gear** is provided to rotate the upper portion or sighting head of the dial sight. It is housed within the horizontal boss on the casing in which it is retained by a screwed ring at the left-hand end and a torsion spring ring at the other. The screwed ring is secured in the boss by a set screw, whilst the torsion spring ring has a grub screw in its periphery to act as a feather to engage a slot in the right-hand end of the boss to place initial tension on a torsion spring around the sleeve. Two slots are provided on the exterior of the torsion spring ring for the application of a spanner to rotate the ring against the pressure of the spring, and in its inner face are five equally spaced holes to engage one end of the torsion spring, the other end of the spring engaging in a hole in a torsion spring washer feathered to the sleeve. The torsion spring ring is finally secured, after adjustment, by two set screws in the

boss. Feathered to the left-hand end of the sleeve is a lever by which it is rotated, when desired to disengage the teeth of the worm from those of the worm wheel for quick setting of the sighting head.

The sleeve is bored eccentrically throughout its length to receive the worm spindle and cut away externally to enable the teeth of the worm to engage the worm wheel. Pressure on the lever rotates the sleeve and disengages the teeth of the worm from those of the worm wheel, against the pressure of the torsion spring. On releasing the lever the torsion spring causes the teeth to re-engage one with the other.

The worm spindle is formed with a worm at its centre and a flange near the right-hand end to bear against the end of the sleeve in which it is secured by a nut at the left-hand end. The extremities of the spindle are each formed square to receive collars and knurled heads, and bored each end internally for the clamping screws which secure these fitments in position.

Interposed between the collars and the knurled head at each end of the spindle is a micrometer drum. Each drum is graduated in 10 minute intervals for five degrees and numbered 0–20–40–0 for each degree.

The right hand knurled head is provided with a stop screw which engages a similar stop screw on the right clamping screw after the rotation of the latter for 120 degrees, to prevent the loss of the screw when releasing the screw for adjustment of the drum. The right-hand clamping screw is provided with an extension to form a thumb piece.

The **sighting head** consists mainly of a casing, erector and diaphragm, mirror gear, and diaphragm window. It is a complete unit and houses the upper optical components.

The **casing,** of aluminium alloy, is secured to the dial plate and consists of a circular plate with a tubular projection on its under surface to receive the erector and diaphragm, the lower end of which is screw-threaded externally to receive the erector and diaphragm securing ring, and a rectangular box-shaped receptacle on its upper surface to contain the mirror with its gear, object glass and upper prism. The upper surface is open and prepared with two screw-threaded apertures, the front one to receive the object glass with its cell, and the rear one for a brass tube. At the upper end of these apertures a seating is prepared to receive the upper prism which is retained in position by a U-shaped clip, the whole being protected from damp and damage, by a cover secured by six screws.

On the left-hand side of the box portion a rectangular face is prepared to receive a No. 1 sight illuminating apparatus, or a cover plate when the apparatus is not in use, a small rectangular opening being provided to allow the bulb of the apparatus to illuminate the diaphragm. The apparatus or cover are secured by six screws.

On the right-hand side a face is prepared to receive the mirror gear and diaphragm window, apertures being provided for the insertion of the items concerned.

The front of the box is provided with a parallel-sided optical glass window to protect the optical components and to permit the entrance of the rays of light from the object viewed. It is retained in position by a plate. A hooded portion is provided on the box to protect the window from rain and glare.

On the rear side of the box is a face prepared to receive an arrow plate for the mirror gear, and the engraving EL, DEP and 1 TURN = 8° filled in with white. Below the engraving is a screw-threaded hole in which is positioned a desiccating screw, the head of which is painted red.

An aperture is provided in the under surface to permit the insertion and removal of the object glass.

The **erector and diaphragm** is a brass tube which is provided with an external flange at its lower end to form a stop against the lower end of the tubular projection on the casing, where it is retained by the securing ring. It is screw-threaded externally at both ends, the upper for a diaphragm cell and the lower for the erector lens cell.

The **mirror gear** is provided in the sighting head to raise or lower the image of an

object not in the same horizontal plane as that of the gun so that it can coincide with the graticules.

It consists mainly of an aluminium alloy box having a flange with five holes for the screws which secure it to the casing. It is bored from right to left to receive the mirror pivot and its components, whilst above this boring a further boring, from front to rear, accommodates the worm spindle with its bush and sleeve. An arrow is provided, filled in white, to read in conjunction with an index line on an open sight index drum.

Pivoting in the box is the mirror pivot which is provided with a platform at its inner end to carry the mirror with its mount and spring to prevent jar, near which is formed a bearing to fit the bearing in the box. On the inside of this bearing three tapped holes are provided for screws to secure a quadrant to it, the quadrant being provided with a 90 degree segment of worm teeth to gear with those of the worm spindle secured to the quadrant by three screws in the open sight index drum. The drum is provided with an index line to read in conjunction with the arrow on the box, a recess at this end accommodating the open sight plate. The outer end of the mirror pivot carries an open sight plate on which is secured an open sight with fore and hind sights for rough laying. The sight has free movement around the pivot and is kept friction tight by a slotted nut and spring washers. Elevation is given to the open sight by application of the finger on the knurled thumb piece secured to the open sight plate.

The mirror is rotated in elevation by a worm spindle carried in bearings in the sleeve at the rear end and a bush at the front, where it is retained by a flange on the spindle coming up against a shoulder in the interior of the sleeve, a thrust washer being interposed, and a spring washer, thrust collar and nut at the front end of the spindle. Midway between the sleeve and bush the spindle is provided with a worm thread to engage the teeth of the quadrant. Positioned within the sleeve and accommodated on the spindle are five stop collars which limit the movement of the mirror pivot in the vertical plane.

Positioned on the rear end of the worm spindle is a knurled head to which is secured a collar, between which is clamped an index collar. On the periphery of the index collar is engraved a scale for four divisions on each side of a zero mark, one end being marked — and the other + to read in conjunction with the arrow on the arrow plate on the casing.

The **diaphragm window** is provided in the casing to illuminate the graticules of the diaphragm by means of a hand torch in the event of the No. 1 sight illuminating apparatus not being fitted. The window, of glass, is carried in an aluminium alloy frame secured to the casing by two screws. A projection is formed on the rear of the frame in which is prepared a slot to convey the light to the graticules.

Optical arrangements

The optical components (Fig. 45) of the dial sight combine to produce an erect image of the object at the eyepiece, and consist of a mirror, object glass, upper prism, diaphragm and field lens, erector, centre prism, erector, lower prism, and eyepiece. It is in effect two complete telescopes placed end to end, the first one ending at the upper erector lens and the second telescope beginning at the lower erector lens, the centre prism joining the two together. This optical system is designed for simplicity in production and eliminates the complicated double reflecting roof prism in the previous types replacing it by a simple right-angle prism.

The **mirror** is provided to turn the rays of light from an object through 90 degrees on to the object glass, and is arranged in such a manner in its mount that it can be elevated or depressed through a limited angle to bring the object viewed into coincidence with the graticules of the diaphragm, as previously explained.

Bearing in mind that the image in the mirror is viewed from the eyepiece, situated to the rear of it, it becomes clear that the reflection is inverted relative to the eye. This inverted image is passed on to the object glass.

The **object glass** is contained within a cell which is screwed into the front aperture in the upper surface of the casing of the sighting head. It is inserted to form an image of the object at its focal point, which is three inches from the face of the glass.

The glass is a combination of two pieces in contact, one of crown glass, which is

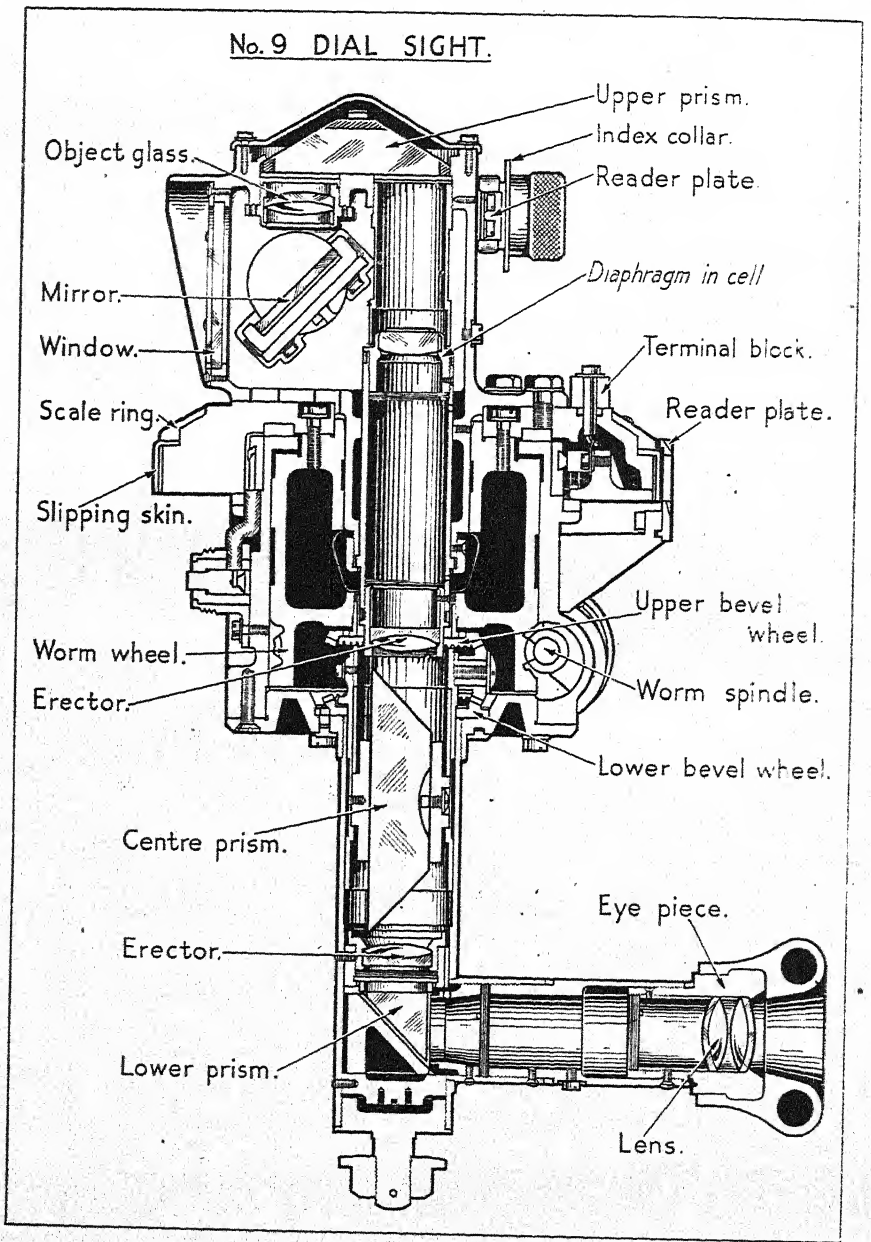


FIG. 45

bi-convex, and the other of flint glass, and is single concave, the two together preventing the rays of light from being split up into their component parts, thus giving a rainbow effect. It inverts the image right for left and upside down.

The combination of the two glasses forms a lens which is termed achromatic and

provides a clear-cut image. An erect image is, therefore, passed on to the upper prism.

The **upper prism** is positioned with its hypotenuse or longer side facing the object glass and diaphragm, and retained in this position by a clip in the upper surface of the casing of the sighting head, and protected from damage by a cover.

The other two sides of the triangular prism act as mirrors, therefore, the rays of light from the object suffer two internal reflections to turn the rays at 180 degrees on to the diaphragm, where the image is again erect.

The **diaphragm** is positioned in its cell at the upper end of the tube of the sighting head and performs the dual function of a diaphragm with cross-lines, and the field lens of the eyepiece of the upper telescope. In effect the object glass, upper prism, diaphragm and upper erector are a complete telescope, the eyepiece of which is formed by the diaphragm and upper erector.

It is a single convex lens, its upper flat surface being positioned at the focal length of the object glass to prevent parallax, and etched with cross-lines or graticules. The graticules are in the form of cross-lines with gaps at their centre. The lower half of the vertical line is lengthened until it is level with the horizontal line, therefore, the top of the lower line is used for laying on the desired point. The gap in the vertical line is 15 minutes in height, whilst the horizontal gap is 30 minutes in width (15 minutes each side of the vertical line). This lens does not invert the image up for down.

The **upper erector lens** is positioned in its cell at the lower end of the tube of the sighting head, and is identical with the object glass. It receives an erect image from the diaphragm or field lens which it inverts and passes on to the centre prism. This lens is, in effect, the eye lens of the upper telescope.

The **centre prism** is an ordinary right angle prism with the right angle portion removed, as it not required. It is secured in a holder in the supporting pillar, and can be rotated in the horizontal plane to maintain an erect image in the eyepiece.

If the upper and centre prisms were placed in close contact, and the upper one rotated clockwise laterally, the image would appear to revolve clockwise in the centre prism, but in a vertical plane through a corresponding angle. To counteract this effect, and to ensure that the layer views the object the correct way up at all times, the centre prism is made to revolve on a vertical axis, at half the speed of the upper prism, as previously explained in the mechanical arrangements.

The **lower erector lens,** together with the lower prism and eyepiece is, in effect, the lower telescope, of which the erector lens forms the object glass and is an identical lens to the object glass. It is positioned in a cell in the bronze bush in the interior of the supporting pillar. It inverts the image up for down and right for left.

The **lower prism** is a right angle prism positioned in the lower end of the supporting pillar to turn the rays of light from the lower erector lens through 90 degrees so that the image may be viewed by the layer through the eyepiece without moving from his seat. It is retained in position by a mount and screwed plug.

In the process of turning the rays of light the image is again inverted, so that an erect image is viewed through the eyepiece.

The **eyepiece** is in a cell in the eyepiece tube, its function being to magnify and view the image of the object, and consists of two similar achromatic bi-convex lenses, an eye and field lens.

It is a fixed positive eyepiece which does not invert the image, and is a fixed focus, but, owing to the low power, both the image and graticules will be in correct focus for all except those with very abnormal eyesight. The advantage of having the eyepiece fixed is that the sight can be made water-tight.

The **Mark I No. 10 dial sight** is manufactured for Home Service use for training purposes, and will not be taken overseas on active service. It is simple of

manufacture and was designed for ease of production to increase output whilst waiting for the No. 9 to be issued. It differs mainly from the No. 9 as follows :—

(*a*) It is not provided with a centre prism with 2 to 1 gearing, its place being taken by an external prism at the eyepiece which has to be rotated by hand to maintain an erect image as the sighting head is rotated.

(*b*) Due to speed of manufacture and the external erecting prism, it is not water-tight, and for the same reason it is easily liable to be put out of adjustment and damaged.

(*c*) It is not manufactured in three complete assemblies which are interchangeable one dial sight with the other, as is the No. 9, but has to be returned to workshops for repair in the event of damage.

(*d*) It is not provided with fittings for a No. 1 sight illuminating apparatus to illuminate the graticules.

(*e*) It has no upper prism, the mirror turning the rays of light at 90 degrees down the supporting pillar on to the diaphragm.

(*f*) The lower right angle prism is replaced by a pentagonal prism.

The **Mark II No. 7C dial sight** (Fig. 46) is a conversion from the Marks II and II* No. 7 dial sight, and is normally used for indirect laying in conjunction with the No. 6A or 7A directors. It is the primary means of laying for direction and gives an all-round field of view.

The upper part can be revolved horizontally through a complete circle, independent of the eyepiece, thereby allowing the layer to observe objects in any direction without moving the position of his eye, due to the height of the upper prism above the eyepiece.

The dial sight consists of two main sets of components, the mechanical arrangements and the optical arrangements, none of which may be tampered with, except by a person holding a certificate of competency issued by the Military College of Science.

The mechanical arrangements provide for the retention of the eyepiece in a fixed position in the carrier, while the upper portion of the sight, carrying the upper prism, is capable of horizontal movement through a complete circle by means of worm gearing, the amount of angular movement being recorded in divisions of 10 minutes.

The worm can be thrown out of gear to permit of rapid setting of the sight. To provide for the target or aiming point not being on the same horizontal plane as the carriage, the upper prism is capable of a limited angular movement in the vertical plane, a small open sight or view-finder being provided to facilitate the operation of picking up the point to be layed upon.

The optical arrangements consist of a series of prisms and lenses combining to produce an erect image of the object, as viewed from the eyepiece, combined with a magnification of four diameters and a field of view of 10 degrees. The sight is water-tight throughout.

It consists of the following principal parts :—

Mechanical arrangements

Supporting pillar
Eyepiece case
Eyepiece cell
Lower prism mount
Object glass adapter
Centre prism holder
Worm wheel
Worm wheel bracket
Worm gearing
Dial plate
Index plate
Upper prism holder mount
Upper prism holder case
Crosshead.

The **supporting pillar** forms the means of attachment of the sight to the carrier and contains the lower optical arrangements.

It consists of a steel tube, enlarged at the top and screw-threaded for its attachment to the worm wheel bracket. Just below the screw-threaded portion a flange is prepared, on the exterior, its under surface being formed with a coned seating to fit over the top of the dial sight carrier.

A lower bevel wheel is rigidly attached to the top, and the interior is prepared

to receive a centre prism holder, object glass adapter, lower prism mount, eyepiece case and plug. The plug screws into the lower end, and has a projecting screw with a slotted nut, the nut being adjusted to engage the catch of the dial sight carrier, so preventing the sight from lifting.

Near the coned seating a small plate is fitted, and, during manufacture, can be

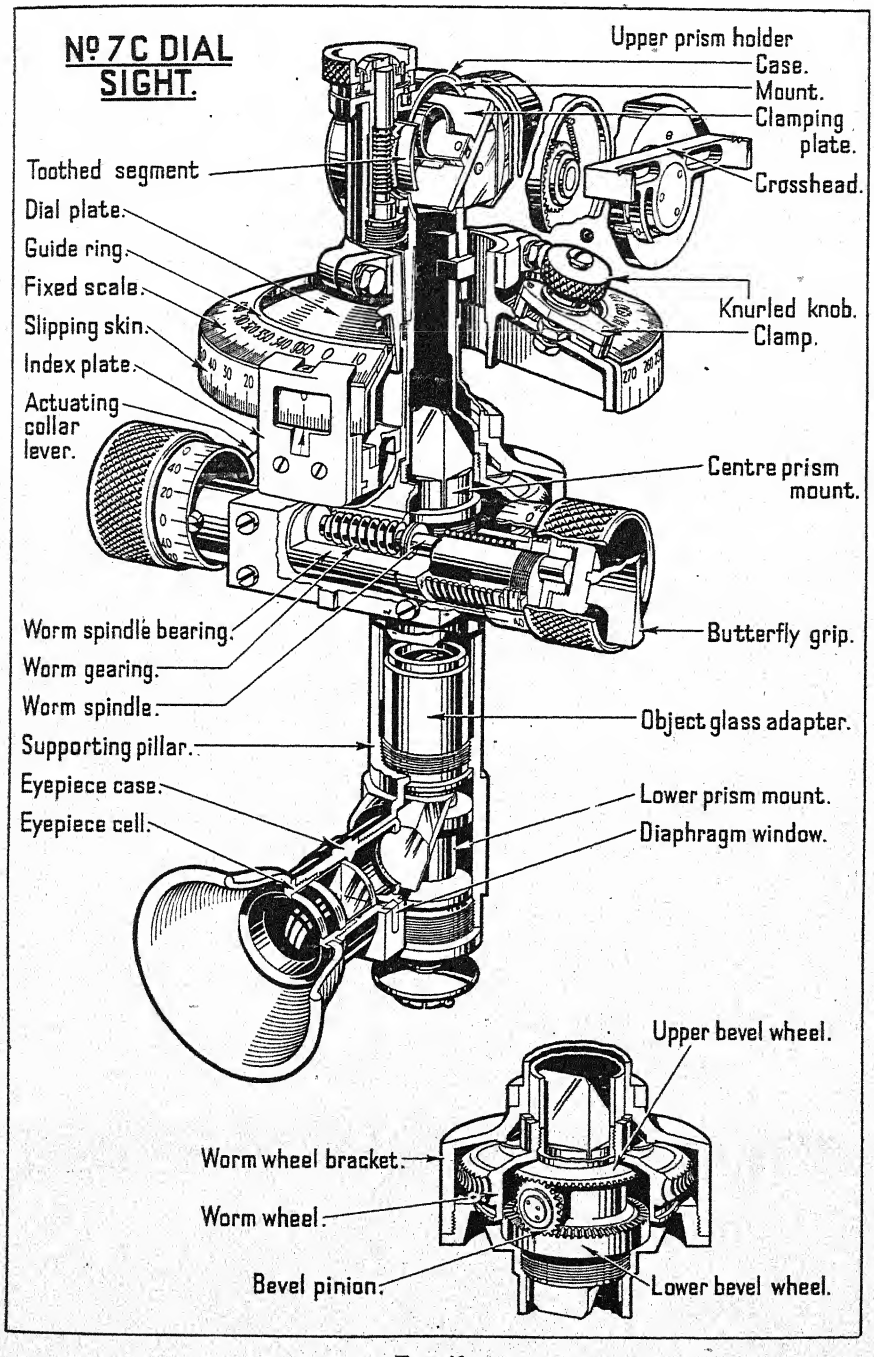


FIG. 46

removed for the adjustment of the lower bevel wheel. This adjustment must not be made after the sight has been issued to the Service.

The **eyepiece case,** of steel, contains the eyepiece cell and diaphragm. It is screw-threaded externally, at one end, to screw into the supporting pillar, whilst screwed into its outer end is the eyepiece cell.

A diaphragm window, of glass, is secured in one side of the case, by a steel securing piece, to allow light from a lamp to reach the graticules on the engraved diaphragm, when the sight is used at night.

The **eyepiece cell,** of steel, is screw-threaded externally for attachment to the case, and is prepared with a groove for the attachment of the No. 11 detachable rubber eyeguard.

Internally, it is prepared to receive the eyepiece lenses with their distance ring, and at its inner end, it is screw-threaded internally for the attachment of a brass cell containing an engraved glass diaphragm.

The **lower prism mount,** of brass, supports a lower prism, and is in two parts. It is a tight fit in the supporting pillar, where it is secured by two screws passing through the supporting pillar plug, and adjusted by two screws diametrically opposite each other.

The **object-glass adapter,** of steel, is screw-threaded externally to screw into the interior of the supporting pillar, just above the lower prism mount, and screw-threaded internally, at its upper end, to receive the object-glass and its cell.

The **centre prism holder,** of steel, is prepared internally with screw threads to receive the centre prism with its mount. It fits accurately into the supporting pillar, and has a projection on which is pivoted a steel bevel pinion of 24 teeth, the pinion being secured by a screw. A bearing washer is interposed between the holder and the prism.

The pinion gears simultaneously with the lower and upper steel bevel wheels, each with 64 teeth. The lower bevel wheel is secured by a steel ring with tommy holes.

The **worm wheel,** of manganese bronze, is centred on the projection of the supporting pillar. Around its largest circumference are cut 72 teeth, hobbed to suit the worm, each tooth representing 5 degrees.

It is furnished with a brass bearing washer and a steel spring washer, and is fitted internally with the upper bevel wheel, the wheel actuating the bevel pinion, revolving the centre prism holder.

The upper end is prepared to receive the upper prism holder case and dial plate.

The **worm-wheel bracket,** of steel, screws over the supporting pillar, the upper portion forming a bearing for the worm wheel.

One side is prepared to take the worm gearing, and a projection on the opposite side fits between the adjustable and securing screws of the dial sight carrier.

The **worm gearing** contains a manganese bronze bearing bored eccentrically to receive the steel worm spindle, the latter being furnished with two washers. An actuating collar is fitted to one end of the bearing, the lever of which, when pressed upwards, revolves the bearing, thus disengaging the worm from the worm wheel for rapid setting.

A spiral spring is placed between the worm wheel bracket and the bearing, thereby causing the worm to re-engage with the worm wheel when the lever is released. The spring is kept under tension by means of a collar with spring washer and nut, the latter having slots for the application of a spanner, and forms the means of adjustment to take up wear and backlash in the worm spindle.

To each end of the worm wheel bracket is pinned a micrometer head clamping collar, between which and a clamping cap, is secured a nickel silver milled ring, and a brass micrometer head graduated drum. The drum can be adjusted by means of the clamping caps, the right-hand one having a butterfly grip, and the one on the left is provided with tommy holes.

Readings of less than a degree are obtained on the left and right micrometer drums which are graduated in 10-minute intervals around the circumference, the complete scale representing 5 degrees. Each degree is figured 0–20–40–0 to obviate personal errors when setting. The graduations are read in conjunction with arrow heads engraved on the worm wheel bracket.

The **dial plate,** of brass, is secured by three screws to the worm wheel and upper prism holder case.

The fixed scale is secured to the plate by means of five screws with nuts, with a guide ring interposed, and is engraved with an anti-clockwise scale reading from 0 to 360 degrees in multiples of a degree, with every 10-degree graduation numbered. All lines and figures are filled in with white paint on a black background.

The periphery of the plate is provided with a brass slipping skin engraved with a clockwise scale reading from 0 to 360 degrees in multiples of a degree, with every 10-degree graduation numbered. All lines and figures are filled in with black paint on a polished and lacquered background.

The plate is provided with a clamping screw, with knurled head, to enable the slipping skin to be clamped to the plate at the desired reading.

The **index plate,** of brass, is secured by two screws to the worm wheel bracket, and is provided with two readers, the upper one for the scale on the dial plate and the lower for the scale on the slipping skin, the latter being read against an index line, filled in with white paint, on a small sloping surface. A rectangular hole is cut, between the two readers, to view the graduations on the slipping skin.

The **upper prism holder mount,** of manganese bronze, contains the upper prism, and is circular in shape, with circular openings, in the front and bottom surfaces. On one side, at the rear, are cut annular teeth to engage the crosshead pinion; a recess at the rear has a toothed segment with securing pin. The segment is hobbed to engage the worm spindle. The outer surface fits accurately into the upper prism holder case which forms a bearing for it.

The **upper prism holder case,** of steel, is screwed on top of the worm wheel, and contains the upper prism with its mount and elevating gear, in addition to closing the upper end of the supporting pillar. It is prevented from independent movement by means of eight securing screws and two lugs formed on the dial plate.

A dial plate collar, in two parts with lead lining, is clamped, by means of two screws with nuts, over the securing screws, to prevent their being tampered with or working loose.

An optical glass window at the front prevents the entrance of rain to the optical components. It is held by a plate and secured by a large cap with tommy holes.

A hole is bored through the right-hand side of the case for the pivot of the crosshead, and a vertical bearing is formed for the worm spindle which engages the toothed segment of the mount.

The spindle has tommy holes at one end, and is prepared for a keep pin at the other, the lower end resting on a bearing washer and is retained in position by a small cap.

The upper end is provided with a manganese bronze worm spindle bearing engraved HIGHER and LOWER with suitable direction arrows, the engraving being filled in with black wax. Above the bearing is a spring washer and a clamping collar, and a graduated brass micrometer head drum and a nickel silver milled ring, held by a clamping cap, completes the assembly.

The gearing permits of the sight being layed on a point above or below the level of the carriage by raising or lowering the upper prism by means of the milled ring. Each complete turn of the ring elevates or depresses the line of sight through 5 degrees, to a maximum of 17 degrees each way.

The **crosshead,** of steel, is provided with fore and hind sights for picking up the target or aiming point. To effect coincident movement in the vertical plane between the upper prism and the crosshead, the latter is arranged to move at twice the speed of the former.

The pivot pin passes into the holder case on the right-hand side, and has mounted on it a crosshead pinion with 12 teeth and a spring, the pinion being secured by a nut engaging with the annular teeth on the holder mount. As the teeth of the latter are struck to twice the radius of the former, any movement of the crosshead will be twice that of the upper prism.

Optical arrangements (Figs. 47)

Upper prism	Lower prism
Centre prism	Glass diaphragm
Object glass	Eyepiece

The **upper prism** is a right angle prism, mounted in the upper prism holder mount in such a manner that it can be rotated in the vertical and horizontal plane.

It acts as a mirror, giving a constant angle of reflection of 90 degrees. These reflected rays occur so long as the incident rays do not strike the reflecting surface at a greater angle than 47½ degrees. This is called the critical angle.

Rays of light from an object strike the longer or reflecting surface of the prism and are turned down the tube to the centre prism, where the image is viewed upside down.

As the prism is elevated, to enable an object at fairly long range to be observed, the rays from the object may strike the reflecting surface at a greater angle than the critical angle and so pass straight through the prism without reflection. To obviate this the reflecting surface is silvered, the silvering being blackened for protection.

The prism rests upon a brass packing piece, being pressed on to the latter by means of a spring acting on an aluminium alloy clamping plate. Side movement is prevented by means of the cap screwing into the side of the mount.

The **centre prism** is an ordinary right-angle prism with the right angle portion removed, as it is not required, and secured in a mount so that it can be rotated in the horizontal plane.

The prism is inserted in the sight to counteract the effect of the upper prism. Just as the upper prism inverts the image so does this prism, the combination of the two producing an erect image of the object.

If the upper and centre prisms are placed in contact and the upper one rotated clockwise laterally, the image of the object would appear to revolve clockwise in the centre prism, but in the vertical plane, through a corresponding angle.

To counteract this effect and ensure that the layer views the object the correct way up all the time, the centre prism is made to revolve on a vertical axis at half the speed of the upper prism, as explained previously in the mechanical arrangements.

The prism is held firmly, by a set screw, in a brass mount screwed into a steel holder.

The **object glass** is inserted to form the image of the object at its focal point, and inverts the image upside down and right for left.

The glass is made up of two pieces, one of crown glass and is bi-convex and the other of flint glass and is single concave, the two together preventing the rays of light being split up into rays of different colours, and gives a clear-cut image. This combination glass is termed achromatic, the focal point being 3 inches from the face of the glass.

The **lower prism** (Fig. 47) is inserted to turn the rays from an object at right angles to the supporting pillar so that the image can be comfortably viewed by the layer, and to counteract the effect of the object glass. This is accomplished by the prism having two reflecting surfaces inclined at 90 degrees to one another, instead of only one, as with other right-angle prisms. Such a prism is known as a roof prism.

The image from the object glass enters the roof prism reversed both for up and down and right for left but leaves the prism correct as regards up and down and right and left.

The prism is held in a mount which is prevented from upward and side movement by being in contact with the object glass adapter and the eyepiece case.

A **glass diaphragm** (Fig. 47) is positioned between the lower prism and the eyepiece at the focal point of the object glass, this being the position where a real image of the object is formed by the object glass.

It is engraved with two cross-lines with gaps at their centres. Some diaphragms have the lower half of the vertical line lengthened until it is level with the horizontal line. In this case the top of the lower line is used for laying on the desired point.

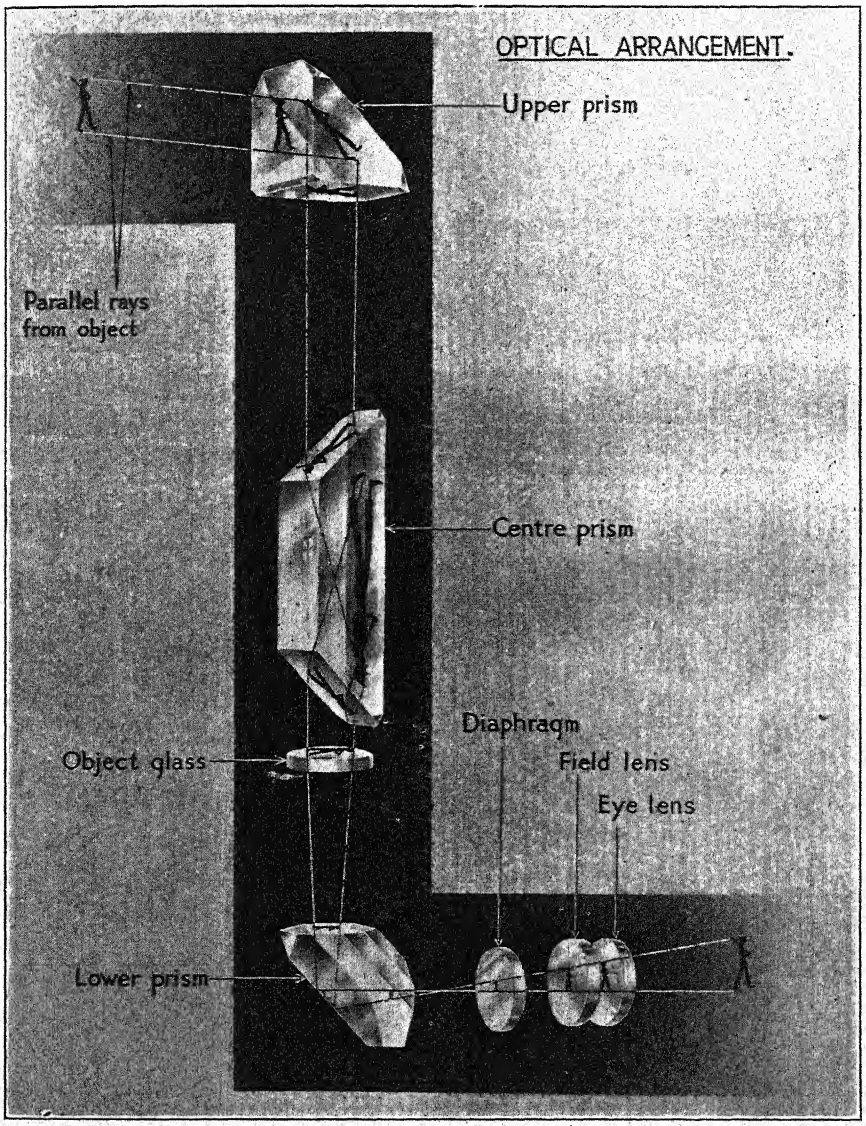


FIG. 47

The **eyepiece** is positioned in the sight to magnify and view the image of the object, and consists of two bi-convex achromatic lenses, the eye lens and the field lens.

It is a fixed positive eyepiece which does not invert the image, and cannot be focussed, but, owing to the low power, both the image and cross-lines will be in correct focus for all except those having very abnormal eyesight. The advantage of having the eyepiece fixed is that it can be made watertight.

The **Mark II No. 7B and No. 7A dial sights** are conversions from the Mark II No. 7 dial sight and differ from the **Mark II No. 7C** in that the method of conversion to the slipping skin type is not so simple, involving a complete dismantling of the sight.

A different method of clamping the right minute drum is employed. In addition,

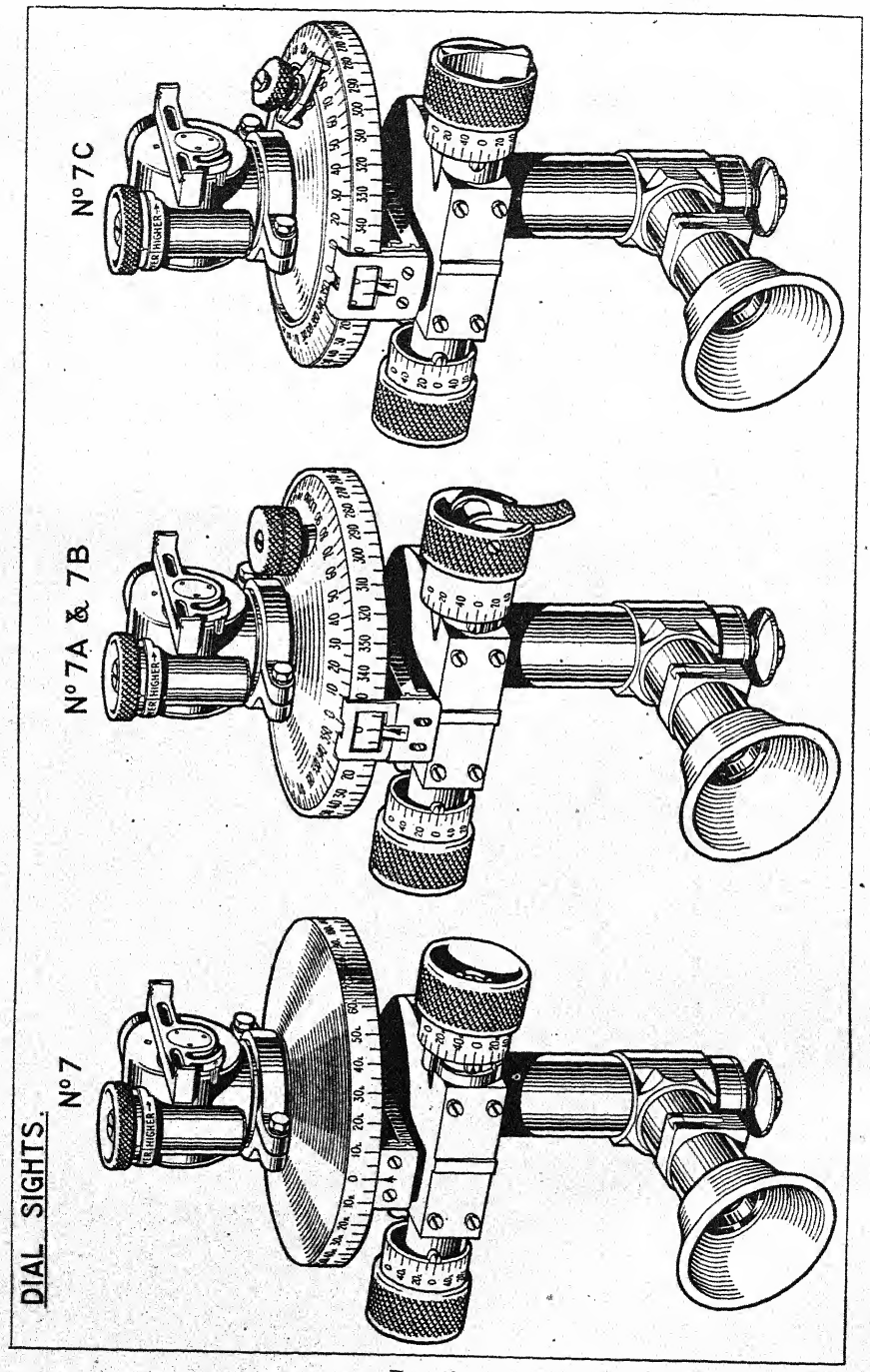


FIG. 48

the No. 7B differs from the No. 7A dial sight in an alternative modification being carried out to the worm wheel stem.

The **Mark II* No. 7A dial sight** is a conversion from the Mark II to II* No. 7 dial sight and differs from the **Mark II No. 7A** only in the numbering of the graduations of the minute drums.

The **Mark II** No. 7A dial sight** is also a conversion from the Mark II or II* No. 7 dial sight and differs only in the method of clamping the right-hand minute drum, being similar to that described for the Mark II No. 7C dial sight.

The **Mark IV No. 7 dial sight** is now obsolescent and differs from the **Mark II No. 7A** dial sight principally in the following particulars :—

(*a*) A clicking device is fitted to the right drum, the clamping collar having five radial grooves on its inner face to engage the ball of the clicker clamped to the body. The grooves are opposite each whole degree of graduation on the drum.

(*b*) The dial plate is graduated in degrees from 0 to 180 right and left, the numeral, with the appropriate letter R or L being engraved every 10 degrees.

(*c*) No slipping skin with clamping screw is provided.

(*d*) The micrometer drums are engraved with the letters R or L against the 20 and 40 numerals.

(*e*) The reader plate is designed to provide for one reader only.

(*f*) The knurled ring of the right micrometer drum is not fitted with a clutch bracket with lever, for releasing or securing the drum to carry out adjustments.

(*g*) The sight can only be used in conjunction with the No. 6 or No. 7 directors.

The Marks I*, II* and III* No. 7 dial sights are all fitted with clickers and are converted from the original Marks I, II and III No. 7 dial sights to approximate to the Mark IV No. 7 dial sight.

The following table shows which dial sights can be used in conjunction with the various directors, due to the difference in the azimuth angles on the various patterns.

For use with No. 6 directors	For use with Nos. 6A, 7 and 7A to 7C directors
No. 7, Mark I*	No. 7A, Mark II
No. 7, Mark II*	No. 7A, Mark II*
No. 7, Mark III*	No. 7A, Mark II**
No. 7, Mark IV*	No. 7B, Mark II
	No. 7C, Mark II
	No. 9, Mark I
	No. 10, Mark II
	No. 10, Mark II*
	No. 10, Mark III

Care and preservation

The sight, when issued from the R.A.O.C., is in correct adjustment, watertight, and with all cells and joints secured by fixing screws.

The body of the instrument must be cleaned with a clean, soft cloth and a little oil, which must be rubbed off afterwards. It is unlikely that the interior will require to be cleaned, and the dial sight must on no account be taken to pieces, except by a person holding a certificate from the Military College of Science stating that he is qualified to do so.

The eye lens and window should be cleaned with soft, old cotton sheeting only, which must be kept perfectly clean and dry, and be used for this purpose only. The surfaces should only be lightly rubbed when being cleaned.

No oil or grease of any kind should be allowed to get on the lens or windows, nor should they be touched with the fingers.

Dermatine or rubber eyeguards should not be unnecessarily exposed to extremes of temperature, to the sun's rays, or to bright light. Oil or grease will inevitably destroy them, and prolonged contact with benzole, petrol or chemicals is undesirable.

If, however, oil or grease appears, it should be removed, either by wiping with a clean rag soaked in benzole or petrol, or by washing in water to which a little soap and soda have been added, finally well rinsing in clean water, or by wiping off with a clean dry rag. French chalk is useful to absorb oil from rubber.

Spare eyeguards should be stored in a wooden box completely filled with french chalk (so as to exclude air). The box should be as nearly airtight as possible. The eyeguards should be stored in such a way that they are not distorted. If french chalk is not available, eyeguards should be kept under water. If, after being in store for some time, the eyeguards lose their pliability, they can generally be rendered supple, when required for use, by steeping them in warm water.

The dial sight should be removed from the carrier when the equipment is being moved. When not in use, it must be kept in its case.

TELESCOPE, PANORAMIC, M.6

The M6 telescope is similar in construction, and is used for the same purpose, as the Nos. 7 to 7C dial sight of British manufacture. It differs mainly in that the azimuth scale is enclosed in a case and viewed through a window. It is divided into two consecutive semicircles each graduated in intervals of 100 mils. The graduations on each semicircle read from 0 to 3,200 mils. The micrometer is graduated in 100 spaces, each representing one mil (3.375 minutes), and reads from 0 to 100 in both clockwise and anti-clockwise directions, each being coloured differently. The micrometer can be rotated independent of the worm for correctional purposes.

The recticle (diaphragm) is provided with a grid scale with the zero cross lines passing through the optical axis of the telescope. The horizontal scale is graduated in mils, by 10-mil steps, and numbered on each side of the centre from 10 to 40. The vertical scale is graduated in hundreds of yards, by steps of 200 yards. The divisions are numbered from 200 to 1,200 yards. The range graduations are situated below the horizontal line. This type of telescope permits one man to lay both for line and elevation against moving targets.

TELESCOPE, SIGHTING, NO. 29

The No. 29 sighting telescope (Fig. 49) is used for anti-tank shooting. It is achromatic and of the erecting type with a direct reading range scale; an object glass protector is provided as well as a No. 3 detachable eyeguard. Three tools are supplied for the telescope.

The following are its optical characteristics :—

Magnification	1·9 diameters.
Field of view	21 degrees.
Apparent field of view	39 degrees 54 minutes.
Overall length (including eyeguard) ..	17¾ inches.

The telescope consists principally of the following parts :—

Body, erecting lens cover, object glass, object glass protector, adapter body, erecting lens, fixed diaphragm, moving diaphragm, diaphragm box, clicker, T.E. disc, actuating screw, knurled head, eyepiece and eyeguard.

The **body** is a steel or manganese bronze tube and accommodates the adapter body and object glass. It is screw-threaded internally at the front end to take the object glass cell tube, whilst a small rectangular hole is cut in the right rear for the erecting lens cover. A key is riveted to the under side to engage in a keyway in the telescope holder. Towards the front end of the interior a light stop ring is secured by means of a small screw, while the adapter body slides into the tube from the rear, a small U-slot being cut in the periphery of the tube to position the adapter.

The **erecting lens cover,** of brass, consists of a catch plate, guide, spring and pin. The cover is secured to the body of the telescope by means of the catch plate and pin,

N° 29 SIGHTING TELESCOPE.

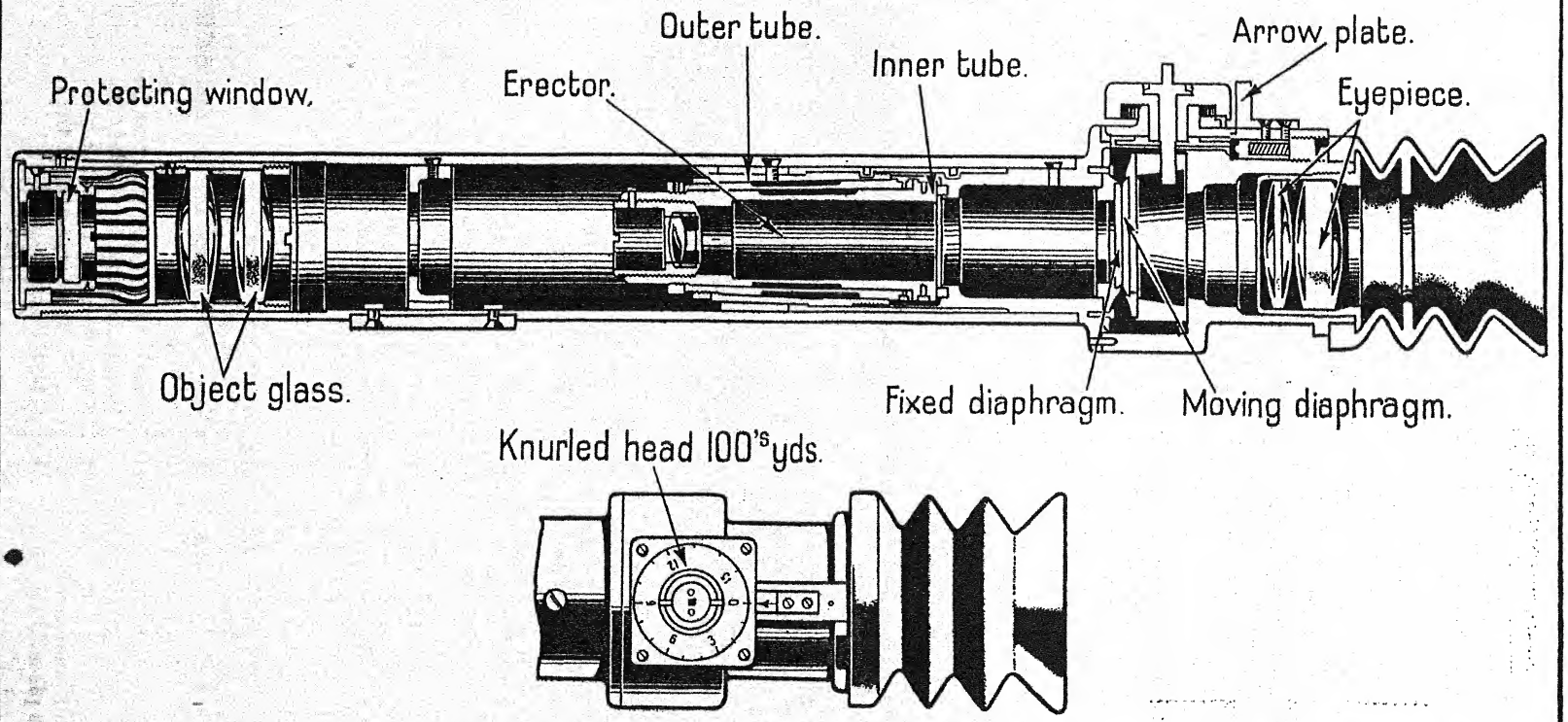


FIG. 49

whilst the lips of the spring engage with the serrated edges of the erecting lens tubes. The cover is removed to enable the erecting lens to be adjusted.

The **object glass** consists of two bi-convex lenses and is mounted in a brass cell and retained in position by a distance ring and counter cell. A steel tube is screwed to the cell and secured by a small screw. The cell tube is flanged at the front and screw-threaded on its exterior for attachment to the tube body. Two U-slots are cut in the flange to facilitate removal of the object glass protector.

The **object glass protector** is fitted with an optical glass window disc mounted in a brass cell with a retaining disc ring. The protector has an expanding spring which bears in a circumferential groove in the interior of the object glass cell tube. The glass window can be easily replaced if damaged.

The **adapter body,** of gunmetal, slides into the tube body from the rear, and is secured by means of six screws. It is flanged to bear against the front of the diaphragm box to which it is positioned by means of a small pin at the bottom and then secured by six screws. The fixed diaphragm is secured to the rear by four screws, whilst a flange in the interior forms a bearing surface for the erecting lens bearing, the flange being grooved to receive a leather washer. The interior at the front is screw-threaded for the reception of the erecting lens bearing, whilst a hole with slots on either side is for the erecting lens cover. The hole coincides with the hole in the tube body.

The **erecting lens** is mounted in a brass cell and retained by a burnishing ring. The cell screws into the front end of the inner erecting lens tube, whilst an outer tube is positioned between the front and rear of the inner tube. The tubes form a double eccentric and pass through a brass bearing which is screw-threaded on the exterior for the reception of the adapter body. The tubes at the rear are flanged, the flanges being serrated on their periphery to enable them to be locked in position by the lips of the spring of the erecting lens cover, whilst recesses for the reception of a tommy are cut in their circumference for adjustment purposes. The lens is allowed adjustment which should not, however, alter the line of sight by less than 45 minutes radius from the mechanical axis of the telescope body.

The **fixed diaphragm,** of optical glass, is contained in a brass cell and is of the direct reading type. The graticules are etched on the left of the glass when looking through the telescope, one above the other, representing 0, 200, 400, 600, 800, 1,000, 1,200, 1,400 and 1,500 yards respectively, the higher ranges being at the bottom.

The **moving diaphragm,** of optical glass, is also contained in a brass cell and secured to the inside of the diaphragm box by four screws. The glass is etched with a thick horizontal line and a thick vertical line ; these lines are thinner within 1 degree 30 minutes on either side of the intersection of the lines in the horizontal plane and 26 minutes on either side of the intersection of the lines in the vertical plane. The thin horizontal line is sub-divided into six equal divisions on each side of the centre line, each subtending 15 minutes. Each 30 minute graduation subtends 10 minutes vertically on each side of the horizontal line, whilst the 15 minute graduation subtends 5 minutes on each side, and as already explained, the centre thin vertical line subtends 26 minutes on each side. The graticules are marked with an R on the left and an L on the right.

These graticules permit rapid corrections being made for line, thus, if the shell falls to the left of the target the use of the graticules on the side marked R will assist in applying the necessary right traverse to the gun, bringing the M.P.I. on to the target.

The range graticules are etched with the highest range at the bottom, therefore the gun has to be elevated to bring this graticule on to the target, and in so doing, applies the tangent elevation to the gun necessary to hit the target, the angle of sight being automatically applied visually. It is necessary that the elevating gear of the sight is placed at zero before using the telescope.

The moving diaphragm is operated vertically by a slider to which it is fixed, moving between two slides. The object of the diaphragm moving is to bring the intersection of the cross lines to the range graticule being used, for ease of observation.

The **diaphragm box,** of gunmetal, is enamelled red and forms the means of housing the moving diaphragm with its slider and slides, clicker and T.E. disc.

A cover is secured to the top by four screws, whilst it is screw-threaded at the rear for the reception of the eye lens cell. The rear end is formed with a flange up against which fits the eyeguard. A recess is formed at the top for the T.E. disc, whilst the clicker is accommodated in a projection in rear of the cover.

The **clicker** is contained within the small projection at the top rear of the diaphragm box and consists of a plunger and spring retained in position by a screwed plug. The end of the plunger has a small V-shaped projection which fits into slots in the periphery of the T.E. disc to prevent it moving during firing and to indicate an exact 100-yard graduation. A small click is heard and felt as the plunger engages the slot.

The **T.E. disc,** of steel, is positioned in the recess at the top of the diaphragm box and secured to the knurled head by three set screws. Before inserting the screws it is positioned by a steady pin on the head entering a hole in the disc. Slots are formed on the knurled head, in which engages the end of the clicker plunger. A hole is bored through the centre through which passes the actuating screw.

The **actuating screw,** of steel, has screw threads at its lower end which engage in a screw-threaded hole in the slider; its upper end is flanged to bear in a recess in the top of the knurled head to which it is secured by a clamping ring and set screws. The upper end is formed square and was originally intended for use with remote control which has since been discontinued.

The **knurled head,** of steel, is positioned on top of the diaphragm box cover and, as previously stated, is secured to the actuating screw and the T.E. disc, therefore, by rotating the knurled head in an anti-clockwise direction, the actuating screw and T.E. disc are revolved, forcing the slider in the downwards direction, and with it the moving diaphragm, bringing the horizontal wire opposite the necessary graduation on the fixed diaphragm. This position is indicated on top of the knurled head by graduations from 0 to 15, representing hundreds of yards. Each third graduation is numbered, e.g. 3, 6, 9, 12 and 15, whilst all graduations and figures are filled in with white paint or wax.

The ranges are read in conjunction with an arrow which is engraved on an arrow plate, the latter being secured to the top of the projection housing the plunger. Two stop faces are prepared on the lower surface of the knurled head, which, in conjunction with a stop pin in the cover of the diaphragm box, limits the rotary movement of the head.

The **eyepiece** consists of a brass cell in which are furnished two bi-convex lenses positioned by distance rings. The two lenses are in contact, that nearest the eye being the eye lens and that further away the field lens.

The cell is screw-threaded, to fit into the rear of the diaphragm box, and flanged to retain the eyeguard. The cell is retained by a small screw.

The **No. 3 detachable eyeguard,** of rubber, is provided to protect the gunlayer's eye from injury during firing and is secured to the telescope by the flange of the eyepiece cell.

On no account should the telescope be adjusted or taken to pieces except by a competent person.

The telescope is housed, when not in use, in a No. 6 telescope sighting case, of steel, which consists of a container, cap, chain and two fasteners, with interior fittings.

TELESCOPE, SIGHTING, NO. 22C

The *Mark III* No. 22C sighting telescope (Fig. 50) is used as an alternative to the No. 29. It is not the same dimensions as the No. 29 and when it is in use a No. 22C sighting telescope adapter, No. 1 must be fitted in the telescope holder of the dial sight carrier.

The telescope is the fixed focus type and has the following characteristics :—

Magnification	1 diameter
Field of view	21 degrees (Approx.)
Overall length	13·5 inches (Approx.).

It consists principally of a body, window, four lenses, glass diaphragm, and rain shade. Except where stated to be otherwise, the metal parts are of brass.

The **body,** which is tubular and one inch external diameter, is screw-threaded internally at the eye end to suit the threads of a locking ring and the fourth lens cell, whilst a screw-threaded collar is pinned and soldered to the exterior at the other end to take the adapter for the object glass cell.

A stop collar, with a key on the under side, is pinned and soldered to the exterior of the body and, in rear of it, a distance collar is similarly attached to the interior.

The stop collar and its key serve to position the telescope in the adapter whilst the distance collar ensures the correct assembly of the optical components between it and the eyepiece.

The body is slightly undercut on the exterior for about half its length, and bearing surfaces are prepared at each end of the undercut portion. Except for the bearing surfaces, the interior of the body is optical blacked and the exterior bronzed and lacquered.

The **window and the four lenses,** which are of equal focal length, are each spun into individual cells each of which is screw-threaded on its outer circumference. The cells of the second and third lenses each screw into tubes which act as distance pieces in the telescope.

The **glass diaphragm** is contained in a diaphragm cell and secured in position by a locking ring. A key pin is soldered to the interior of the cell at the bottom, the pin being contoured to suit a radiussed slot in the diaphragm. By means of the key the diaphragm is positioned in the cell and prevented from turning.

The surface of the diaphragm nearer the window is etched with cross lines. A portion of the vertical line, extending for a distance equivalent to 30 minutes above and below the centre, is half the thickness of the remainder of the line whilst a portion of the horizontal line, extending for a distance equivalent to 3 degrees (1 degree 30 minutes on each side of the centre), is similarly reduced in thickness.

On each side of the centre the thinner portions of the horizontal line are each divided, by two short vertical lines, into three equal portions. By means of these short lines a total deflection of 3 degrees (1 degree 30 minutes on each side of the centre), may be measured by increments of 30 minutes. The total length of each vertical line is equivalent to 30 minutes and, as they are equally divided by the horizontal line, it is possible, with the aid of the thin portions of the vertical cross line, to measure angles of elevation and depression of 15 and 30 minutes.

The letters R and L, which are etched below the horizontal line, appear on the left and right of the vertical cross line respectively when viewed through the telescope. A radiussed slot, to suit the key in the diaphragm cell, is provided in the circumference of the diaphragm at the bottom of the vertical cross line. The diaphragm cell is screwed into a diaphragm cell tube which is inserted into the object glass end of the telescope body until an outer flange bears against the end of the body. The tube is secured in the body by a set screw.

An object glass cell adapter is screwed to the external collar at the same end of the body and similarly secured by a set screw. The first lens cell is screwed into the adapter until it meets the flange of the diaphragm cell tube. It is there secured in position by a locking ring which is prevented from turning by a steel grub screw.

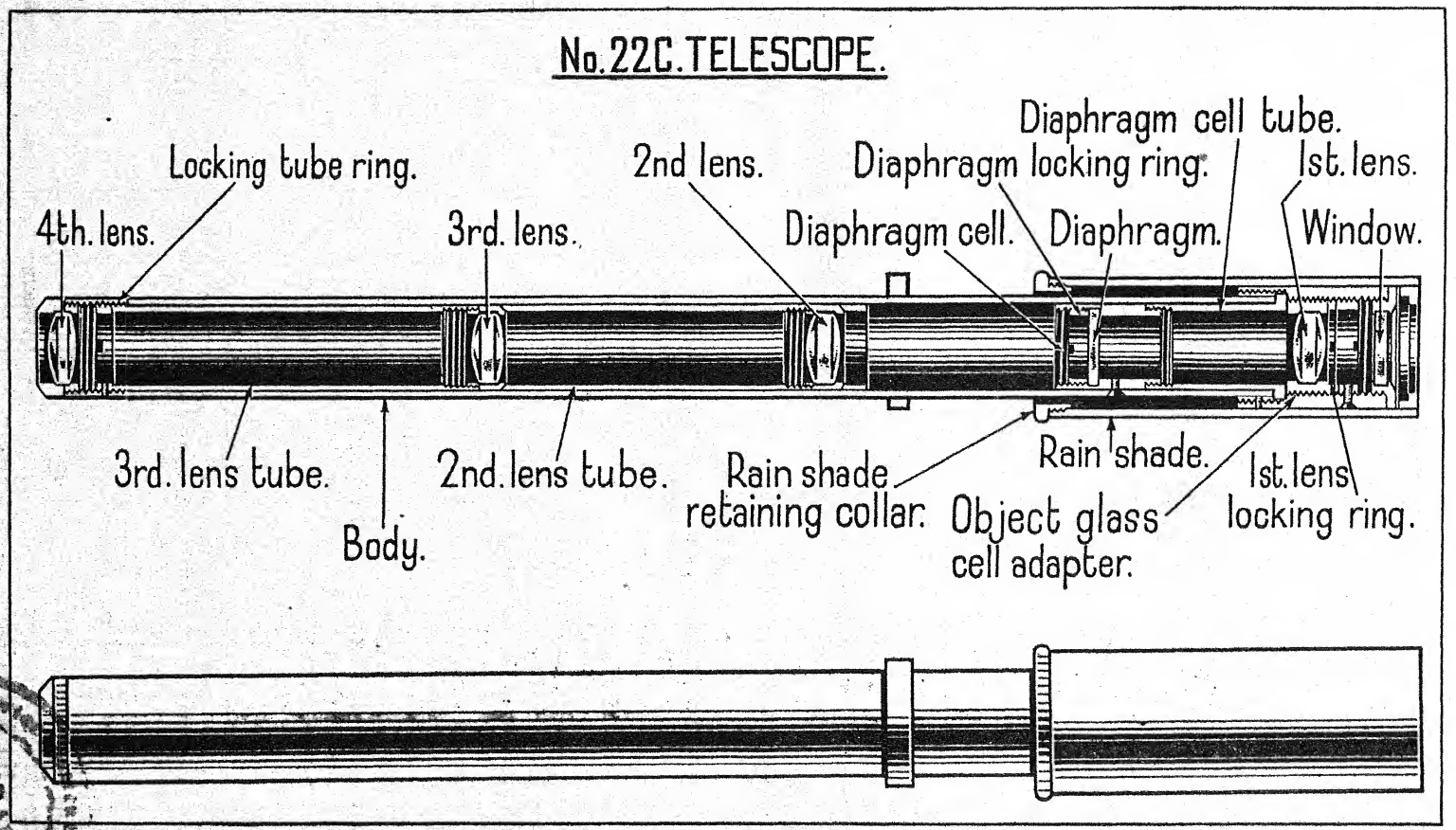

No. 22C. TELESCOPE.
Diaphragm cell tube.
Locking tube ring.
2nd lens.
Diaphragm locking ring.
1st. lens.
4th. lens.
3rd. lens.
Diaphragm cell.
Diaphragm.
Window.
3rd. lens tube.
2nd. lens tube.
Rain shade
Rain shade.
1st. lens
retaining collar.
Object glass
locking ring.
Body.
cell adapter.

Fig. 50

The window cell, which closes the object glass end of the telescope, is screwed into the adapter until its milled outer flange bears against the outer end of the adapter.

The second and third lens tubes, containing the second and third lens cells respectively, are inserted in that order into the telescope body from the eyepiece end until the second lens cell bears against the rear edge of the internal distance collar and the third lens cell bears against the rear of the second lens tube. They are there retained in position by a locking ring, which screws into the telescope body in rear of the third lens tube, and is secured by a set screw.

The fourth lens cell is screwed into the eyepiece end of the telescope until a chamfered flange, which is milled around its outer circumference, bears against the end of the body and closes the telescope at that end.

The **rain shade** is fitted around the object glass end of the telescope and a retaining collar is then screwed inside its inner end. The retaining collar, which has a milled outer edge, is a sliding fit on the body thus permitting the rain shade to project beyond the window when so required. A bush, soldered to the interior of the outer end of the rain shade, limits the movement of the shade in the direction of the eyepiece whilst the inner edge of the object glass cell adapter acts as a stop for the retaining collar when the shade is slid in the opposite direction.

The *Mark II* telescope differs from the *Mark III* in the method of mounting the diaphragm and object cell, and is obsolescent.

The telescope is housed in a No. 12 sighting telescope case, when not in use.

The case is of cadmium-plated steel, cylindrical in form, the lid of which engages the case, in the locked position, by means of a bayonet socket fitting.

The lid is retained on the case by 2·5 inches of flexible Bowden wire to prevent it becoming completely detached.

The No. 22C telescope will be replaced by the No. 41 Mark IS telescope as available.

TELESCOPE, SIGHTING, NO. 41

The No. 41 sighting telescope (Fig. 51) is of the fixed focus, external pupil type, and requires only a small aperture for sighting purposes. It has a magnification of 1·9 diameters and a field of view of 21 degrees.

The **Mark IS telescope** consists of a steel tube, in the front end of which is secured an object glass cell and at the rear end an eyepiece box. Towards the centre, on the under surface, is secured a longitudinal key to prevent rotation of the telescope in the telescope holder. Above this key, on the inside, is secured an optical stop. To ensure the graticules being correctly positioned in the telescope a semicircular recess is cut in the rear end of the tube in which fits a screw on the eyepiece box.

The object glass cell is secured in the front end of the tube and contains an object glass to form the image of the object. The glass consists of two bi-convex lenses with a small air space between them, each lens being composed of two lenses, one being bi-concave and the other bi-convex, placed together to form an achromatic combination. The focal length of the combination of the four lenses is 50-mm.

Secured to the front end of the object glass cell is a No. 3 object glass protector, containing an optical glass window to close the front end of the tube, and so prevent damage to the object glass. The protector is retained by spring clips. The telescope has an external entrance pupil of 0·36-mm. diameter.

The rear end of the tube is closed by an eyepiece box, on the front end of which is secured a tube containing an adapter with erector lens cell and erector. The erector lens is achromatic and consists of a bi-concave and bi-convex lens in contact. This lens counteracts the effect of the object glass, the combined focal length of the object glass and erector being 83·9-mm.

To the rear end of the eyepiece box is secured an eyepiece cell containing a similar combination of lenses to those of the object glass. The focal length of the combined eyepiece lenses is 44·2-mm. the object of these lenses being to magnify and view the image of the object formed by the object glass. Attached to the rear of the eyepiece cell is a No. 3 detachable rubber eyeguard.

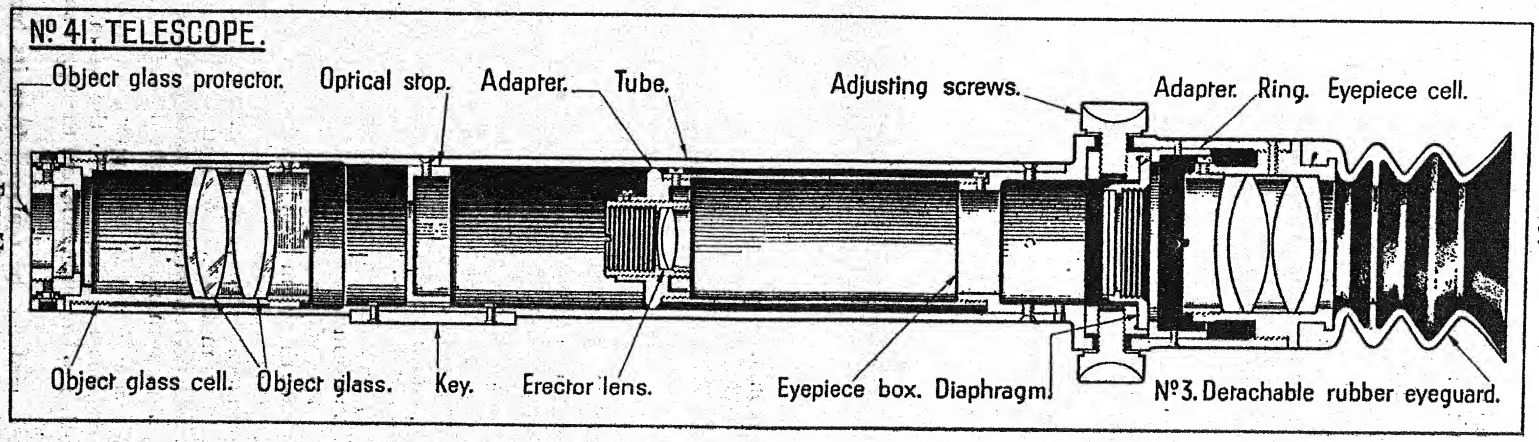

Nº 41. TELESCOPE.
Object glass protector.
Optical stop.
Adapter.
Tube.
Adjusting screws.
Adapter. Ring. Eyepiece cell.
Object glass cell.
Object glass.
Key.
Erector lens.
Eyepiece box. Diaphragm.
Nº 3. Detachable rubber eyeguard.

FIG. 51

Positioned in the interior of the eyepiece box, in front of the eyepiece, is a brass ring which acts as an optical stop for the diaphragm, immediately in front of it.

The diaphragm is spun into a diaphragm ring, which is a push fit in an adapter ring positioned inside the eyepiece box, the diaphragm ring being secured to the adapter ring by four screws. The holes for the screws in the diaphragm ring are elongated to allow for rotary adjustment of the diaphragm. To allow for adjustment of the diaphragm in the lateral or vertical plane, four milled-headed adjusting screws are provided which engage in the adapter ring and move the ring, and with it the diaphragm, in the lateral or vertical plane to make the intersection of the cross lines coincident with the optical axis of the telescope.

Etched on the front face of the diaphragm are a thick horizontal and vertical cross line, the centre of the horizontal line being etched thin for 1 degree 30 minutes on each side of the vertical line and subdivided every 30 minutes, those on the right being marked with an L, and those on the left with an R. The height of the small sub-division lines is 15 minutes above and below the horizontal line. The vertical cross line is etched thin for an amount of 30 minutes above and below the horizontal line.

All the lenses in the telescope are achromatic, that is, they are constructed in two parts in contact, one of crown glass and the other of flint glass. This combination improves definition and cuts out colour.

The optical stops mask the outer edges of the lenses enabling the centres only, to be used for magnification.

If the lenses were left unmasked, a blurred image would result, due to the outer edge of the glass bringing the image to a different focus.

The whole of the interior of the telescope is optical blacked to prevent internal reflection.

The *Mark IIS telescope* is generally similar to the *Mark IS*, differing only in the entrance pupil being 0·432-mm. diameter.

SIGHT CLINOMETER

The sight clinometer is used in conjunction with the dial sight carrier when laying indirectly. It can be set to read the angle of sight, the range corresponding to the tangent elevation being set on the cone.

The *Mark IV* sight clinometer (Fig. 52) consists principally of a cradle with worm spindle and spring retaining clips and a toothed arc with spirit bubble in case.

The **cradle** is of manganese bronze with the upper surface recessed and grooved to receive the arc. The under surface fits into the supporting bracket on the left elevating arc, where it is retained by two hinge retaining clips. The clips are actuated by means of a spiral spring, which presses a plate against the inner arms of the clips forcing them downwards and outwards. An appropriately marked scale, from 0 to 20 degrees elevation and depression, is engraved on the outer face and read against an arrow on the arc. The worm spindle passes through the cradle and is supported at each end in bearings, one of which is pivoted to the cradle. The other end can be pressed downwards to release the worm from the arc when necessary for quick setting. A flat spring, riveted at one end to the cradle, tends to keep the worm and arc in gear and to prevent backlash between them. An adjustable micrometer collar, graduated to read minutes in multiples of 5, is attached to each end of the spindle. One collar is marked E with each numeral and is used with the elevation side of the degree scale, whilst the other is marked D for the depression side.

The **arc** is shaped to slide evenly in the upper portion of the cradle and teeth are cut round the under surface to engage with the worm. An adjustable reader for the degree scale is fitted to the outer side and the upper surface is shaped to take an L glass spirit bubble.

The sight clinometer need not be removed from its bracket when firing, but should be removed when travelling and placed in its case.

The *Mark III* differs from the *Mark IV* in the nature of the retaining clips. The spring is horizontal, the clips are of slightly different shape, and a stop for the clips is fitted to the under side of the cradle. The P bubble is fitted instead of the L bubble, the former being radium treated.

The *Mark II* differs from the *Mark III* in small manufacturing details and in being fitted with the L bubble.

The Mark II* has the P bubble and is marked R.

The Mark I has the L bubble but is otherwise identical with the Mark III.

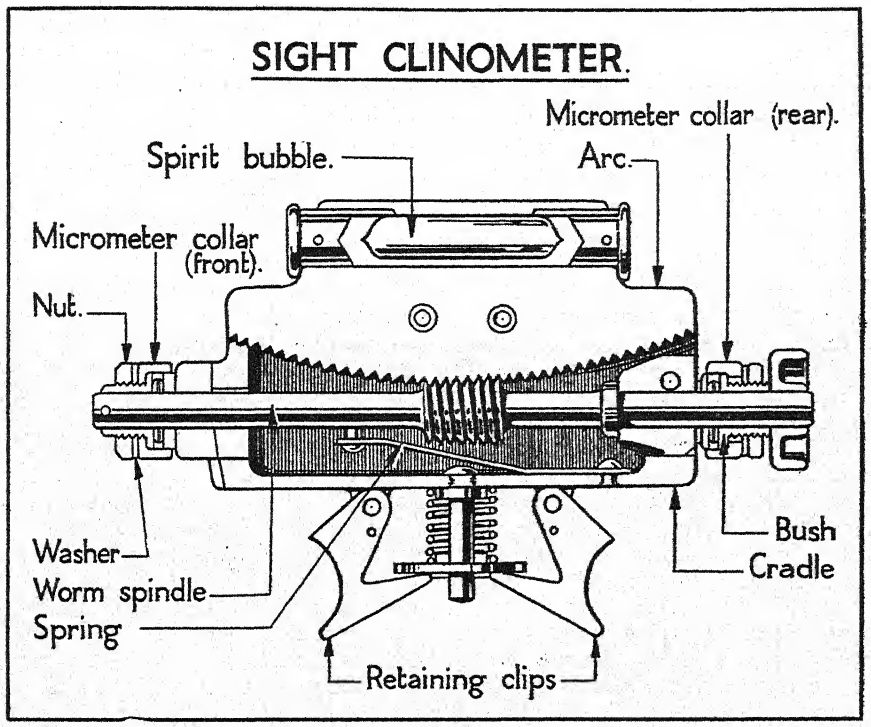


FIG. 52

NOTE.—No more radium-treated bubbles will be issued. Those already in use will be replaced, when unserviceable, by a non-luminous bubble and the R on the sight clinometer barred out. The Mark III is thus altered to Mark I and the Mark II* to Mark II.

ADAPTER, MARK I, NO. 18, NOS. 7 TO 7C

DIAL SIGHT CARRIER

The adapter is provided to enable the M.6 American panoramic telescope to be used with the No. 18 carrier. It is formed with a flange having a projection at the front to fit between the securing and adjusting screws of the dial sight socket to allow adjustment for line.

Below the flange it is machined to fit into the dial sight socket, where it is retained by the catch pin of the socket engaging in a cannelure in the lower end. Above the flange a projection is formed, which is hollowed and slotted vertically to receive the panoramic telescope, two screw-threaded holes being drilled to receive screws to secure the telescope in the adapter.

SIGHT TESTS

General remarks

The tests and adjustments are based on the following values of jump, which are being published in a reprint of the range table.

	Marks II and III guns on Mark I carriage	
	Without muzzle brake	With muzzle brake
Charge I	+ 21 mins.	+ 17 mins.
Charge II	+ 23 mins.	+ 18 mins.
Charge III	+ 26 mins.	+ 11 mins.
Super charge	+ 20 mins.	— 1 min.

Sight tests fall into two categories as follows :—

(*a*) Tests which are to be carried out daily and after periods of prolonged firing (Tests 1, 2, 5 (*a*), 6 (*b*), 7 and 8).

(*b*) Tests which are to be carried out occasionally, e.g. weekly. The adjustments for these tests (3, 4, 5 (*b*) and 6 (*a*)), when necessary, will not be carried out except by a qualified artificer.

The tests and adjustments under (*a*) will be carried out frequently, in order that all ranks concerned are practised, both in the tests, and in the resulting adjustments.

After an adjustment has been made, as the result of any test, the test will be repeated, in order to ensure that the adjustment has been accurately carried out.

The details of tests 5 (*a*) and 5 (*b*) depend on the Mark of range scale plate in use and also on whether or not the gun is fitted with a muzzle brake.

The Mark I (modified) and Mark II range scale plates incorporate the correct allowance for jump when used with guns without muzzle brakes.*

The Mark III range scale plate incorporates the correct allowance for jump when used with guns with muzzle brakes. It will not be used except on such guns.

No special allowance for jump is, therefore, required during sight testing with either of the above combinations of equipment.

When Mark I (modified) and Mark II range scale plates are used on guns fitted with muzzle brakes, the error in the allowance for jump at charge III is compensated by applying an additional elevation of 15 minutes to the gun in tests 5 (*a*) and 5 (*b*). No corrections are then necessary during observed shooting with any charge. The corrections which are required during predicted shooting with charges I, II or super are given in the range tables.

The type of telescope in use does not affect the sight test, but the method of adjustment is different for each type of telescope as follows :—

(*a*) *No. 22C telescope*—The adjustment for line is made by means of adjusting screws in the sides of the telescope adapter. The adjustment for elevation is made by means of a slipping sleeve on the knurled knob of the telescope adapter.

(*b*) *No. 29 telescope*—The adjustments, both for line and for elevation, are made by means of the erecting lenses.

(*c*) *No. 41 telescope*—The adjustments, both for line and for elevation, are made by means of four radial adjusting screws in the telescope. These screws move the diaphragm horizontally and vertically.

The range scales of the No. 29 telescope and the No. 1 adapter of the No. 22C telescopes are set and left at 400 yards throughout sight testing and zeroing. The No. 41 telescope has no adapter and no range scale.

For all types of telescope, and with the open sight, ranges for the engagement of targets are set on the range scale plate.

The range scales of the No. 29 telescope and the No. 22C telescope adapter are

* Except that, Mark I (modified) plate there is a small error with charge I. The appropriate corrections for use in predicted shooting with charge I are given in the range tables.

therefore, left set at 400 yards, except that the setting will be 500 yards when firing charges super or super plus increment from guns with muzzle brakes when fitted with Mark I (modified) or Mark II range scale plates.

A table should be painted on the shield for recording data regarding sight testing and shooting as follows :—

	Adjusting pin	Dial sight (cowl)
(1)	(2)	(3)
For sight testing		(*a*) Zero
For shooting	(*b*)	(*b*)

The settings in column 2 refer to the setting of the adjusting pin of the telescope holder. The setting recorded at (*a*) will always be " 6 " unless it is found that :—

With this setting, there is an insufficient throw in the telescope adjusting devices to allow alignment to be made for elevation

or

With this setting, there is an insufficient throw in the adjusting pin to allow zeroing to be carried out.

In either of the above events, any convenient setting other than " 6 " may be chosen. The settings recorded at (*b*) are determined as the result of zeroing.

Preparation for sight testing

Certain of the tests described hereafter are dependent on the correct adjustment having already been made in certain of the previous tests. The tests will, therefore, always be carried out in the sequence as laid down.

Before the tests are begun, the carriage will be placed on a firm platform as nearly level transversely as is possible, and the breech and muzzle clinometer plane will be inspected in order to ensure that they are free from grit or paint.

When the sights testing target is to be used, the following preparations will be made before tests 6 to 8 are begun :—

(*a*) The sight testing target (Fig. 53) will be set up about 50 yards in front of the gun, and at right angles to the axis of the bore. If the carriage is not level transversely, the top of the dial sight carrier and the sight testing target must be sloped at the same angle as the carrier as follows :—

(i) Lay the gun horizontal and place the carrier testing plane in the dial sight socket.

(ii) Place a field clinometer transversely on the breech clinometer plane and move the slider (and the arm if necessary) until the bubble is in the centre of its run. Note the reading.

(iii) Place the field clinometer transversely on the carrier testing plane, with the toothed arc pointing to the same side of the gun as before, and with the arm and slider set as in (ii). Bring the field clinometer bubble to the centre of its run by means of the cross-levelling gear.

(iv) Tilt the target to the angle noted in (ii) by means of a plumb bob used in conjunction with the arc painted on the target.

(*b*) If the carriage is level transversely, ensure that the top of the dial sight carrier and the sights testing target are also level transversely.

(*c*) Carry out the preparations as detailed, when using a distant laying mark (*b*) to (*i*) below.

(*d*) Lay the bore on point B of the target by means of the elevating and transversing hand wheels. Check to see that the vertical crosswire is aligned on the line and rectangle above B, *i.e.*, check to ensure that the tilting of the target described in (*e*), has been correctly carried out.

When a distant laying mark is to be used, the following preparations will be made before tests 6 to 8 are begun :—

(*a*) Select a laying mark, *i.e.*, a well-defined object at least 1,500 yards distant.

(*b*) Fit crosswires on the muzzle of the gun, or on the muzzle brake, using the engraved axis lines. These crosswires are used as a foresight in laying the bore on the distant object.

(*c*) Remove the striker case, complete with striker. The firing hole is then used as a hind sight in laying the bore on the distant object.

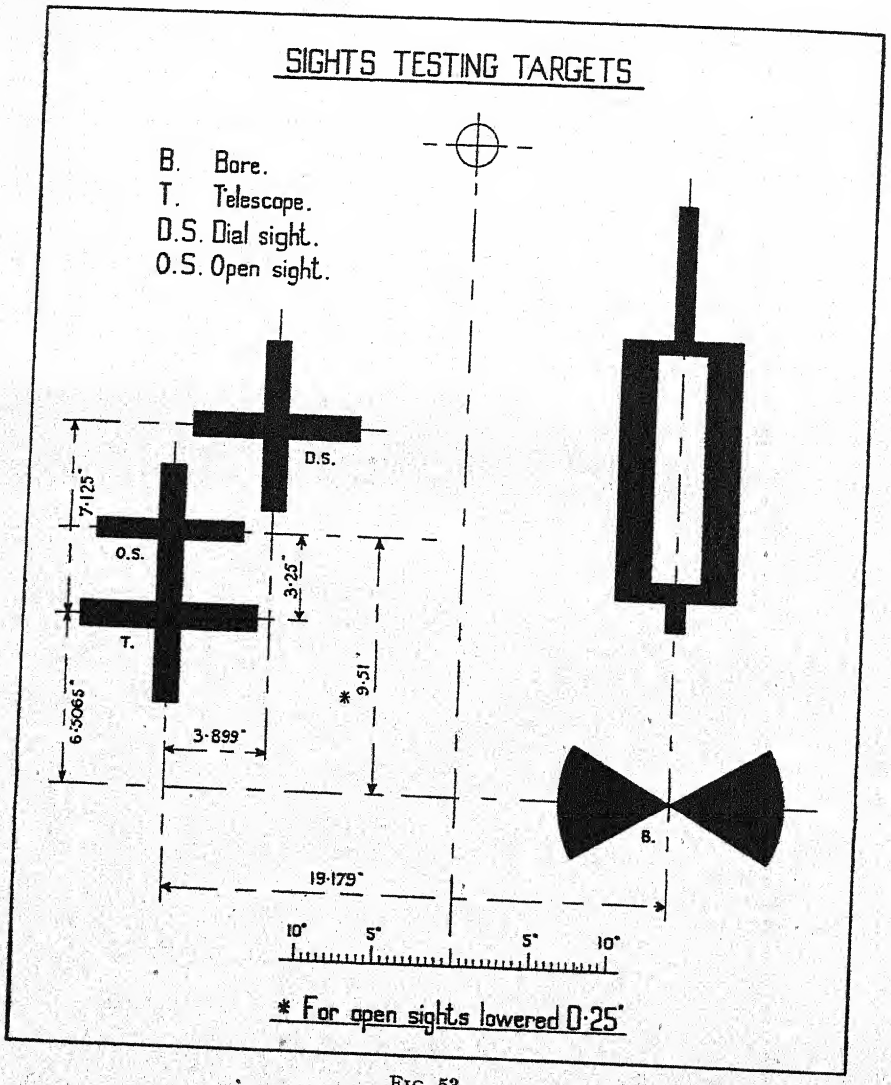


FIG. 53.

(*d*) Set the range scale plate at zero T.E.

(*e*) Set the main scale of the dial sight at zero degrees zero minutes.

(*f*) Set the main and micrometer scales of the cowl of the dial sight at zero.

(*g*) Set and lock the adjusting pin of the telescope holder at the setting recorded on the shield for sight testing.

(*h*) Set the range scale of the No. 29 telescope or No. 22c telescope adapter at 400 yards.

(*i*) Set the deflection scale of the open sight at zero.

Test 1—To find the correction for index error of the field clinometer

The object of this test is to determine whether the field clinometer accurately records the angle at which the gun is laid.

Set the clinometer to zero* and place it on the breech clinometer plane. By means of the elevating hand wheel, bring the clinometer bubble to the centre of its run. Turn the clinometer end for end and replace it on the clinometer plane. The bubble should again be in the centre of its run.

If the bubble is not in the centre, bring it there by moving the slider (and the arm, if necessary) and note the reading. Half this reading is the correction for index error of the clinometer, and this correction must be applied to all angles ordered to be set on the instrument, e.g. :—

Reading of clinometer when turned end for end, and the bubble brought to the centre of its run	+2 minutes
Correction for index error	+1 minute
To lay the gun at 20 degrees quadrant elevation, set the clinometer at	20 degrees 1 minute

Whenever practicable, the clinometer should be adjusted by an artificer to eliminate the index error as follows :—

(*a*) Set the clinometer to read the ascertained index error and place it on the clinometer plane. Bring the bubble to the centre of its run by elevating or depressing the gun. Set the instrument at zero, replace it on the clinometer plane, and with the instrument in that position, bring the bubble to the centre of its run by manipulating the adjusting screws of the bubble tube, the gun remaining as before.

(*b*) Reversing the instrument end for end should not alter the central position of the bubble. Should it do so, proceed as before, until there is no change.

The adjustment to the bubble is made by two capstan nuts in the Mark III, by three grub screws in the Marks IV and V, and by an adjusting screw with clamping screw in the Mark VI clinometer.

At least one clinometer in the troop must be kept so adjusted, and this clinometer must be used for the quick sight test.

Test 2—To test and adjust the zero of the sight clinometer

The object of this test is to ensure that the sight clinometer bubble is in the centre of its run when the sight clinometer is set at zero degrees zero minutes and the sight clinometer bracket is horizontal.

(*a*) Set the sight clinometer at zero, place it in its bracket and bring the bubble to the centre of its run by means of the elevating hand wheel. Turn the clinometer end for end and replace it in its bracket. The bubble should again be in the centre of its run.

(*b*) If the bubble is not in the centre, bring it there by turning the micrometer head of the sight clinometer. Note the reading and set the micrometer scale to half this reading.

(*c*) Bring the bubble to the centre of its run by means of the elevating hand wheel. Turn the clinometer end for end and replace it in its bracket. The bubble should be in the centre of its run.

(*d*) If the bubble is not in the centre, an error has been made in (*a*) and (*b*). Repeat these operations from the beginning until turning the clinometer end for end as described in (*c*) does not disturb the central position of the bubble.

(*e*) Slacken the micrometer scales securing nuts and, holding the micrometer head, slip the scales to zero and reclamp. If necessary, slacken the securing screws

* "Zero" when applied to a field clinometer or sight clinometer means 0 degrees, 0 minutes.

of the reader of the degree scale, move the reader to zero and reclamp. Check the adjustment by repeating the test.

Test 3—To test the sight clinometer for consistency

The object of this test is to disclose inconsistency in the sight clinometer.

(*a*) Set the sight clinometer at zero, place it in its bracket and bring the bubble to the centre of its run by means of the elevating hand wheel.

(*b*) Turn the micrometer head clockwise for two or three complete turns and then turn it back, anti-clockwise, until the bubble is again in the centre of its run, taking care not to over-run the central position. Note the reading.

(*c*) Repeat operation (*b*), but turning the micrometer first anti-clockwise and then clockwise.

(*d*) Any difference between the readings noted in (*b*) and (*c*) is an error due to insensitiveness of the bubble, or backlash in the gears, or both.

(*e*) Repeat the steps of (*a*) to (*c*), but with the clinometer set initially to 5 degrees elevation and then 5 degrees depression, and note the errors in each case.

(*f*) If the clinometer cannot be adjusted by an artificer to reduce all errors to two minutes or less, then the clinometer must be exchanged.

Test 4—To test the cross-levelling gear

The object of this test is to ensure that the dial plate is level transversely when the cross-level bubble is in the centre of its run.

(*a*) Set the sight clinometer at zero degrees zero minutes and bring the bubble to the centre of its run by means of the elevating hand wheel. Fix the carrier testing plane in the dial sight socket, and place a field clinometer, set at zero, corrected if necessary for index error, along the transverse positioning marks. Bring the bubble of the field clinometer to the centre of its run by means of the cross-levelling gear. The bubble of the cross-level should now be in the centre of its run.

(*b*) If the bubble is not in the centre, the carrier of the bubble should be adjusted by an artificer.

Test 5—(*a*)—To test and adjust the range scale gear

The object of this test is to ensure that the T.E. scale correctly indicates the elevation applied to the gun.

Ensure that the range scale plate and the T.E. pointer are correctly positioned, as follows :—

(*a*) Set the range reader to the extreme right of the reader arm.

(*b*) Bring the range scale gear to minimum elevation stops by means of the range scale hand wheel.

(*c*) If necessary, slacken the securing screw at the apex of the plate and revolve the plate until it is set as follows :—

(i) Plates Mark I (modified) and II.—The 45-degree graduation should be in line with the dot of the range reader.

(ii) Plate Mark III.—The red " setting line " should be in line with the dot of the range reader.

(*d*) Clamp the securing screw and check the setting.

(*e*) By means of the range-scale hand wheel, bring the red " setting line " into line with the dot of the range reader.†

(*f*) If necessary, slacken the securing screws of the T.E. reader plate and move the plate until the T.E. pointer is in line with the zero degree graduation on the T.E. scale.

(*g*) Tighten the securing screws and check the setting.

† In the case of plate Mark III, this step is unnecessary since the alignment has already been secured in (*d*).

(*h*) Set the range reader to the left, away from the T.E. scale.

Test the relationship between the T.E. as read on the range scale plate and the T.E. applied to the gun, as follows :—

(*i*) Set the sight clinometer at zero degrees zero minutes.

(*j*) Set the range scale plate at 20 degrees T.E., i.e. by means of the range scale hand wheel, bring the 20-degree mark on the T.E. scale against the T.E. pointer.

(*k*) Set the field clinometer as follows, corrected if necessary for index error :—

(i) Guns without muzzle brakes and with plates Marks I (modified) and II .. .. 20 degrees.

(ii) Guns with muzzle brakes and with plates Marks I (modified) and II .. .. 20 degrees 15 mins.

(iii) Guns with muzzle brakes and with cones Mark III 20 degrees.

(*l*) Place the field clinometer on the breech and bring the bubble to the centre of its run by means of the elevating hand wheel.

(*m*) Cross-level the sight, and the bubble of the sight clinometer should now be in the centre of its run.

Adjust the range scale gear, if necessary, as follows :—

(*a*) Slacken the lock nuts (and grub screws, if fitted) at the upper end of the sight operating arm.

(*b*) Manipulate the adjusting screws to alter the setting of the adjusting block, until the sight clinometer bubble is in the centre of its run.

(*c*) Check to ensure that the range scale plate is still set at 20 degrees T.E.

(*d*) Tighten the lock nuts (and grub screws, if fitted).

(*e*) Repeat the relationship test (*a*) to (*e*) as described above.

In no circumstances may the No. 1 *use any other means of adjustment than that just described.*

Test 5 (*b*)**—To test the range scale gear for accuracy throughout its range**

The object of this test is to ensure that the agreement between the T.E. scale and the gun, as obtained in test 5 (*a*), applies to all elevations.

Having adjusted the range scale gear as described in Test 5 (*a*), test the accuracy of the settings at other values of T.E. as follows :—

(*a*) Set the sight clinometer at zero degrees zero minutes.

(*b*) Set the field clinometer as follows, corrected if necessary for index error :—

(*i*) *Guns without muzzle brakes, when fitted with range scale plates Mark I (modified) or Mark II and guns with muzzle brakes when fitted with Mark III plates* .. .. 10 degrees.

(*ii*) *Guns with muzzle brakes when fitted with range scale plates Mark I (modified) or Mark II* .. .. 10 degrees 15 mins.

(*c*) Place the field clinometer on the breech clinometer plane and bring the bubble to the centre of its run by means of the elevating hand wheel.

(*d*) Bring the sight clinometer bubble to the centre of its run by means of the range scale hand wheel. Cross-level the sight and check to ensure that the sight clinometer bubble is central.

(*e*) Note the reading of the T.E. scale of the range scale plate.

(*f*) Repeat the above steps with the field clinometer set first at 30 degrees and then at 40 degrees or at 30 degrees 15 minutes and 40 degrees 15 minutes for guns in the class described in (*b*) (ii).

The reading of the T.E. scale, as noted in (*e*), should be 10 degrees, and the readings as noted in (*f*), should be 30 degrees and 40 degrees respectively. These readings apply whether or not muzzle brakes are fitted, and whatever Mark of range scale plate is in use.

If the errors at 10, 30 and 40 degrees exceed 5, 10 or 15 minutes respectively, the sight must be adjusted by a qualified artificer.

Test 5 (*c*)—To test and adjust the M.V. corrector scale readers

The object of this test is to ensure that the correct allowance in elevation will be made for loss or gain of M.V.

(*a*) Inspect the M.V. corrector scale readers to ensure that they are set at the M.V.s of the gun for the corresponding charges.

(*b*) If necessary, unclamp the readers, using the key provided, set them to the correct setting, reclamp, and check the setting,

Test 5 (*d*)—To test the sight and adjust by the parallel motion link

NOTE.—This test and adjustment may only be carried out by an artificer.

(*a*) Push and pull on the carrier to see that there is no play in the gear. If movement takes place, ascertain the cause and remedy same, if possible.

(*b*) Set the adjusting block of the parallel motion link approximately in the centre of its run.

(*c*) Set the sighting gear to minimum elevation stops by turning the range hand wheel in an anti-clockwise direction. Place the sight testing plane in the carrier. Cross-level the sight.

(*d*) Lay the gun at zero degrees, using a tested field clinometer placed on the breech plane.

(*e*) Transfer the field clinometer to the sights testing plane, and bring the bubble to the centre of its run by slackening the lock nuts of the parallel motion link and manipulating the adjusting screw. When the bubble of the field clinometer is central, tighten the lock nuts and check the readings.

(*f*) Repeat (*d*) and (*e*) at 10, 20, 30 and 40 degrees, but this time bring the bubble of the field clinometer central by moving the arm and slider. Note the readings. If they do not agree with the angle at which the gun is laid, note whether the errors are plus or minus.

If the errors are plus, the adjusting block of the motion link requires lowering. If the errors are minus it requires raising.

(*g*) Slacken the lock nut of the adjusting block and move the block in the required direction by manipulating the adjusting and lock nuts. Re-tighten the locking nut.

(*h*) Repeat (*d*) to (*g*) until errors are eliminated or reduced to a minimum.

To test the dial sight

When the range scale cone is set at zero T.E., the cowl of the dial sight at zero and the main scale of the dial sight at zero degrees zero minutes, the line of sight through the dial sight should be parallel to the axis of the bore, i.e. if the bore is laid on a distant object, the dial sight should be laid on the same distant object as regards both line and elevation.

In order to ensure that a spare dial sight may be used to replace a damaged dial sight in action, without the necessity for carrying out an alignment test, all dial sights in the battery, including spares, must be interchangeable. The setting of the adjusting screws of all dial sight sockets within the battery will, therefore, occasionally be tested using a " master " dial sight (Test 6 (*a*)). Any necessary adjustment will be made by an artificer, and the adjusting screws will then be tightly locked, *and will not be moved during subsequent testing of dial sights for line.*

Immediately at the conclusion of the adjustment of the dial sight sockets, all dial sights, including spares, will be tested and adjusted as described in Test 6 (*b*).

Test 6 (*a*)—To test and adjust the dial sight sockets of all dial sights in the battery

The object of this test is to ensure that all dial sights within the battery are interchangeable, in order that a damaged sight may be replaced without the need for carrying out an alignment test.

(*a*) Select one dial sight for use as a battery " master " dial sight and, using this dial sight in each gun in turn, carry out the alignment test in *Test* 6 (*b*).

If the sight is not in alignment, an artificer should slacken the locking nut of the adjusting screw of the dial sight socket and bring the sight into alignment by manipulating the adjusting screw and the wing nut of the securing screw. He should then securely lock the adjusting screw and re-test for alignment.

(*b*) Subsequent sight testing.—The adjusting screws, having been set and locked as in (*a*), will not be moved during the normal alignment test (Test 6 (*b*)).

Immediately at the conclusion of the adjustment in (*a*), all dial sights, including spares will be tested and adjusted by the normal alignment test (Test 6 (*b*)).

Test 6 (*b*)—To test and adjust the dial sight for line

The object of this test is to ensure that the main scale of the dial sight correctly records the horizontal angle between the line in which the gun is laid and the line of sight through the dial sight.

Complete the preparations detailed in " Preparation for sight testing."

When using a distant object as a laying mark, the test is carried out as follows :—

(*a*) Lay the bore on the distant object by means of the elevating and traversing hand wheels, using the intersection of the cross-wires as a fore sight and the firing hole as a hind sight.

(*b*) Cross-level the sight.

The dial sight should now be laid (for line) on the distant object.

When using the sight testing target, the test is carried out as follows :—

(*a*) Tilt the dial sight socket and sight testing target, if necessary, as described previously in " Preparation for sight testing."

(*b*) Lay the bore on point B of the target as described below. Check to see that the vertical cross-wire is aligned on the centre of the line and rectangle above point B, i.e. ensure that the target is correctly tilted.

The dial sight should now be laid (for line) on the point DS of the target.

If the dial sight is not on for line it is adjusted as follows :—

(*a*) With the bore still laid on the distant object, or on the point B of the target, revolve the micrometer heads of the dial sight until the sight is laid (for line) on the distant object, or on point DS of the target.

(*b*) Slacken the securing screws of the dial plate reader and the clamping cap of the left micrometer head.

(*c*) Shift the dial plate reader and the micrometer drum to zero, and re-clamp them in this position.

(*d*) Check the alignment of the bore and the sight.

Test 7—To test and adjust the dial sight for elevation

The object of this test is to ensure that the line of sight through the dial sight is parallel to the axis of the bore when the following conditions are satisfied :—

(*a*) The range scale plate is set at zero T.E.

(*b*) The cowl of the dial sight is set at zero.

(*c*) The main scale of the dial sight is set at zero degrees zero minutes.

At the conclusion of the adjustment in test 6 (*b*) lay the bore on the distant object, or on point B of the target (*Test* 6 (*b*)). The dial sight should now be laid on the distant object, or on point DS of the target.

If it is not, revolve the micrometer head of the cowl until the dial sight is laid on the distant object, or on point DS of the target.

Slacken the micrometer collar clamping cap (Nos. 7A, B or C dial sights) or micrometer collar clamping screws (Nos. 9 or 10 dial sights) and slip the micrometer collar to zero. Re-clamp the micrometer collar, and check that the bore and the sight are still correctly laid.†

† The arrow on the view finder may not now be opposite the zero mark on the cowl. If there is danger that the micrometer head could possibly be wrongly set by one complete turn, the arrow may be erased and a fresh arrow scribed opposite the zero mark.

Test 8—To test and adjust the telescope and open sight

The object of this test is to ensure that the lines of sight through the telescope and the open sight are parallel to the axis of the bore when the following conditions are satisfied:—

(*a*) The adjusting pin of the telescope holder is set at the setting for sight testing.
(*b*) The range scale plate is set at zero T.E.
(*c*) The range scales of the No. 29 telescope or No. 22c telescope adapter are set at 400 yards.
(*d*) The deflection scale of the open sight is set at zero.

When using the distant laying mark, the test is carried out as follows:—

(*a*) Complete the preparations detailed at "Preparation for sight testing."
(*b*) Lay the bore on the distant object.
(*c*) Cross-level the sight.

The telescope and open sight should now be laid (for line and elevation) on the distant object.

When using the sights testing target, the test is carried out as follows:—

(*a*) Complete the preparations detailed at "Preparations for sight testing."
(*b*) Lay the bore on point B of the target.

The telescope and open sight should now be laid (for line and elevation) on points T and OS of the target.

Adjust the No. 22C telescope, if necessary, as follows:—

(*a*) *For line*—Slacken the locking nuts and manipulate the adjusting screws in the sides of the adapter until the telescope is laid (for line) on the distant object, or on point T of the target. Re-clamp the locking nuts.

(*b*) *For elevation*—Revolve the knurled knob of the telescope adapter until the telescope is laid (for line and elevation) on the distant object, or on point T of the target. Slacken the securing screw in the head of the knurled knob, hold the knob stationary and rotate the sleeve until it is at the 400 yard setting. Re-clamp the securing screw.

(*c*) Check the alignment of the bore and the telescope.

Adjust the No. 29 telescope, if necessary, by removing the erecting lens cover and rotating the erecting lenses until the telescope is laid (for line and elevation) on the distant object, or point T of the target. Replace the cover and check the alignment of the bore and the telescope.

Adjust the No. 41 telescope, if necessary, by slackening the four radial adjusting screws and rotating them as required, thus moving the graticule vertically and horizontally until the telescope is laid (for line and elevation) on the distant object, or on point T of the target. Tighten the four adjusting screws and check the alignment of the bore and the telescope.

Adjust the open sight, if necessary, as follows:—

(*a*) *For line*—

(i) Turn the micrometer until, with the detent plunger engaged, the sight is as nearly as possible laid (for line) on the distant object, or on point OS of the target.
(ii) Slacken the clamping screws of the hind sight, accurately align the sight, and then tighten the clamping screws.
(iii) Slacken the clamping screws of the deflection scale plate, move the plate until the zero is opposite the reader of the hind sight, and then tighten the clamping screws.
(iv) Check the alignment of the bore and open sight.

(*b*) *For elevation*—Slacken the clamping nut at the bottom of the fore sight and screw the fore sight up or down until the sight is laid on the distant object, or on point OS of the target. Tighten the clamping nut and check the alignment of the bore and the open sight.

Setting the adjusting pin for shooting

Having tested and adjusted the telescope and open sight as previously detailed, set and lock the adjusting pin of the telescope holder at the reading as recorded on the shield " For shooting."

NOTE.—Except that when testing sights before zeroing, the adjusting pin will be left at the reading recorded " For testing sights," and will remain at this reading until " *Zeroing* " (*a*) to (*i*) has been completed.

Zeroing

The object of zeroing is to ensure that (for elevation) the point of impact coincides with the point of aim at the range at which zeroing is carried out. Zeroing should be carried out at least every quarter of the life of the gun.

The gun is zeroed, using charge III, as follows :—

(*a*) Bring the gun into action on a level platform and test the sights as previously described.

(*b*) Inspect the adjusting pin of the telescope holder to ensure that it has been set and locked at the setting as recorded " For testing sights."

(*c*) Set up a zeroing target † at 800 yards from the gun and as nearly as possible on the same level.

(*d*) Set the range scale of the telescope at 400 yards (telescopes Nos. 22C or 29).

(*e*) Set the range reader at charge III, and the range scale plate at 800 yards.‡

(*f*) Lay, using the telescopes, and fire.

(*g*) If the round misses the target, alter the lead used or the range set on the plate, re-lay and fire, and continue to correct until a hit is obtained.

(*h*) Fire a total of three rounds at the range which gives hits, re-laying accurately on the centre of the target for each round.

(*i*) Re-lay after the last round of the group.

(*j*) Without disturbing the alignment of the bore, set the range scale plate at 800 yards. Slacken the locking plate of the adjusting pin, and rotate the adjusting pin until the telescope is laid (for elevation) on the M.P.I. of the three-round group.

(*k*) Re-clamp the locking plate, and record the reading of the adjusting pin.

(*l*) If the cowl of the dial sight has been graduated for zeroing, revolve the micrometer until the dial sight is laid (for elevation) on the M.P.I. of the three-round group, making the last movement one of depressing the line of sight.

(*m*) Record the reading of the micrometer scale of the cowl.

(*n*) Re-lay on the centre of the target, using the telescope, and fire a check round.

(*o*) Re-lay on the centre of the target, using the dial sight, and fire a check round.

The result of the zeroing is accepted as correct if the two check rounds both strike the target closer to the horizontal white band than half the vertical spread of the three-round group.

The open sight is carried on the telescope holder and is, therefore, automatically zeroed when the telescope is zeroed.

The quick sight test

The object of the test is to disclose gross error. The drill will be carried out immediately after the occupation of a position, or at the first interval in firing, and will also be carried out during any pause in prolonged firing. The complete tests,

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† A convenient target is a black canvas screen nine feet square, divided horizontally and vertically by two white bands three inches wide. The intersection of the white band is used as the point of aim.

‡ For guns with muzzle brakes when fitted with plates Marks I (modified) and II, it will normally save ammunition to open fire with the range scale plate set at 1,000 yards. The drill in this sub-para. (*j*) will, however, be carried out exactly as laid down, i.e. with the plate set at 800 yards.

1 to 8, will continue to be done at least once per day, and will be carried out in full if the following simplified drill discloses an error outside the limits of tolerance allowed.

The field clinometer maintained in adjustment by the G.P.O. (Test 1) will be used for the range scale test.

In no event may response to fire orders be delayed because the following tests are in progress. The tests must be abandoned if fire orders are received.

The quick range scale test

The G.P.O. will order " Quick sight test. Angle of sight zero. Tangent Elevation 20 degrees." Each No. 3 will set the sight clinometer at zero, set the range scale cone at 20 degrees T.E., lay roughly for elevation, cross-level the sight, and bring the sight clinometer bubble to the centre of its run by means of the elevating hand wheel.

The G.P.O. or a deputy, will set the field clinometer as follows, and place it on the breech clinometer plane :—

Guns without muzzle brakes when fitted with range scale plates Marks I (modified) and II, and guns with muzzle brakes when fitted with plates Mark III	20 degrees.
Guns with muzzle brakes when fitted with range scale plates Marks I (modified) and II	20 degrees 15 minutes.

For the purpose of this test, droop may be neglected, and the bubble of the field clinometer should, therefore, be in the centre of its run.

If the bubble is not in the centre of its run, it will be brought so, by moving the slider (and the arm, if necessary) of the field clinometer. If the reading differs from the value given above by less than 10 minutes, the sights are accepted as correct (for elevation). If the reading differs by 10 minutes, or more, the complete tests 1 to 8 will be carried out.

The quick alignment test

The G.P.O., or a deputy, will check that the pieces are parallel when laid at a common elevation on the zero line. If any error is detected and if the error remains after the drill for checking the zero line has been carried out, the sight tests 1 to 8 will be carried out.

Care and preservation

Sights are to be handled with great care. All parts are to be kept clean and working parts well lubricated with clean oil and lightly smeared with anti-corrosive grease when not in use. Bath-brick, emery and other abrasive substance must not on any account be used for cleaning.

The parts of the carriage to which sights are attached must be absolutely clean and free from burrs.

The sight gear will not be taken apart unnecessarily, and adjustment should not be made by scarping or filing except on special authority.

If a sight is taken to pieces for any reason, it must be carefully tested on replacement and, if necessary, adjusted.

The exterior surfaces of the telescopes are to be cleaned with a soft rag and paraffin only. The exterior surfaces of lenses should be cleaned with a piece of linen cloth, which must be kept perfectly clean and dry, and used for this purpose only.

The bearing surfaces of the telescope must be very carefully protected. Any burrs or dents on these surfaces throw the telescope out of alignment.

The field clinometer, sight clinometer and range cone should be tested daily and after prolonged firing. The alignment tests should be carried out as often as possible.

At drill, these tests should be carried out frequently to give officers, warrant officers and N.C.Os. practice in doing them accurately.

The remaining tests (*i.e.* of the cross-levelling gear and the sight clinometer for backlash) will be carried out occasionally.

Optical adjustments to instruments may only be carried out by a qualified artificer.

Before commencing the tests, the gun should be approximately level transversely. The carriage should, if possible, be placed on a firm and level platform.

When it is necessary to make an adjustment to the sights, the test or tests should be repeated to ascertain the accuracy of the adjustment.

ADJUSTMENTS TO FIELD CLINOMETERS

(*a*) *To eliminate an index error.*

(*See* adjustment on page 143).

(*b*) *To ascertain if the bubble axis remains parallel to the longer axis (roll test).*

Having adjusted for *index error*, set the clinometer to read zero, place it on the clinometer plane and bring the bubble central by the elevating gear.

Revolve the clinometer on its longer edge through an angle of 5 degrees to either side, care being taken that the longer edges of the clinometer are approximately parallel to the axis of the gun.

The bubble should remain central. If it moves from the centre, the instrument requires adjustment.

To adjust

If the bubble travels towards the rack when revolved on its longer edge, loosen the lower grub screw next to the edge on which it is revolved, tighten the other lower grub screw until the bubble is again central. If the bubble travels away from the rack when revolved, reverse the operation with the lower grub screws. The clinometer should now be tested for *index error*.

This adjustment is applicable to the Marks IV and V, but not to the Marks III and VI clinometers.

These adjustments to clinometers should only be carried out by those qualified to do so.

TELESCOPES

Telescopes must not be taken to pieces, the lenses removed, or adjustment for collimation attempted, except by a competent person. When not in use, telescopes should be closed up, where capable of being extended, caps replaced and they should be kept in their cases. They must be kept in as dry a place as possible.

The erecting lens covers will be removed only when it is necessary to align the optical axis of the telescope with axis of the piece.

After alignment, the cover will be replaced at once, and the screws tightened home.

The inside of the cover is fitted with springs to prevent accidental rotation of the erecting lenses, which cannot work unless the screws are tightened home.

Leaving the cover off allows the ingress of moist air, which may cause filming of lenses or jamming of the air adjusting system.

The screws must not be removed completely as they are captive screws. Six half turns are sufficient to free the cover.

GENERAL (CARRIAGE)

When assembling a carriage, or mounting a gun, care must be taken that all bearing surfaces are perfectly clean and lubricated.

Every precaution must be taken to avoid damage to parts by rough usage. A hammer should never be used unless a piece of wood or soft metal is used to transmit the blow.

All gears should be tested once a week to ensure they are in working condition.

All gears should be overhauled where backlash is excessive, worn parts being renewed as required. Where bearings are bushed, the renewing of worn bushes will usually remove any slackness due to wear.

All nuts and screws should be properly tightened up, split pins inserted and the various gears correctly adjusted.

Split pins, after insertion, should be well splayed. · Lost or damaged pins should be renewed at once.

Care must be taken that all working parts of the various gears and mechanisms are kept free from dirt or rust. They must be thoroughly cleaned and oiled periodically.

All lubricators, nipples and lubricating holes must be kept clean and oil passages clear.

When cleaning bright or working parts, in no circumstances must coarse grinding material be used, such as sand, emery cloth, files, bath-brick, etc., which wear the surfaces and cause looseness to fitted parts. Oil only will be used.

Dirt and congealed oil must not be allowed to accumulate in the ratch teeth where pawls engage.

The teeth of all pinions and wheels will be well smeared with mineral jelly which has been thinned with lubricating oil, to prevent rust.

Wire ropes must be kept lubricated, treated with consideration and kinks avoided. They must be examined periodically for undue wear and broken strands. Care must be taken to see the ends are properly secured.

Sheaves should be examined periodically to see that they are working freely.

Care must be exercised in the manipulation of all valves, which should be operated with the officially approved tools, *without any additional leverage.*

Spanners and implements provided should only be used for the purpose intended.

Defects and damage should be reported immediately.

Leather for glands, pistons or other joints when kept in store, should be free from dust, and periodically smeared with dubbing to keep them soft and flexible.

Thorough overhaul of the gun and carriage should be carried out periodically, particularly the recoil system, elevating and traversing gears and breech mechanism.

Valves should be inspected periodically for leakage. Should leakage occur after the glands have been tightened, as far as is practicable, the compressed packings should be renewed. If leakage still occurs, a faulty leather packing (where these are also fitted) is indicated and should be replaced.

Leaking glands, fitted with leather packings only, should have these replaced.

Units must ensure that equipments are placed in a state of light preservation before being returned to R.E.M.E. depots. This will also apply when equipments are handed over from one unit to another, if the equipments are expected to remain idle for any appreciable time.

The definition of "light preservation" is that bores of guns will be well oiled or lightly greased. Clinometer planes must be well greased or painted over. External bright or working parts of both guns and carriages must be greased.

TABLE OF WEIGHTS, DIMENSIONS, ETC.

In connection with the information given in the following tables, it should be appreciated that two carriages of the same type and Mark may vary in weight owing to so many components being used to build up a complete carriage, in addition to which, certain tolerances are allowed in the manufacture of many of the components, the result being that weights indicated in the table are only approximate but are sufficiently accurate for all practical purposes.

CARRIAGE, 25-PR., MARK I
TABLE OF WEIGHTS, DIMENSIONS, ETC.

Data	
WEIGHTS (approximate)	Cwt. qrs. lb.
Gun with mechanism	8 3 20
Carriage (without gun stores or firing platform)	24 2 26
Gun and carriage	35 1 20
On carriage wheels	34 1 7
On trailers wheels	29 1 11
Total behind tractor	65 1 27
Pressure of trail on ground	1 0 25
Weight on point of perch—	
Limbered up	0 2 17
Unlimbered	1 2 14
Wheels pneumatic	1 2 7
DIMENSIONS (approximate)	
Height—	ft. ins.
Top of shield—	
Firing position	5 6·75
Travelling position	5 5
Axis of gun	3 10·125
Axis of trunnions	3 9·5
Sight line (dial sight) (object glass)	5 2·25
Eyepiece	4 7·25
Axle	1 4·3125
Clearance	1 1·5
Length—	
Carriage and trailer muzzle to perch eye	25 10·75
Trail, centre line of axle to spade	8 10·5
Horizontal distance trunnion to axle	2 4·625
Spade—	
Width	2 7·625
Depth	0 6·75
Wheels—	
Diameter	2 10
Width of tyre	0 9
Width of track	5 10·5
Maximum width of carriage over axle	6 11·5
Locking angle, carriage and trailer	50 degs. L. 50 degs. R
Space required to turn in, carriage and trailer manhandled	31 6
MISCELLANEOUS DATA	
RECOIL GEAR	
Recoil, metal to metal	42 inches
Nominal length of recoil—	
Zero	36 inches
Maximum elevation	20 inches
Maximum force of recoil—	
Zero (charge 3)	3·25 tons
Maximum elevation (super charge)	9·0 tons
Pressure in air reservoir—	
Initial (lb. per sq. in.)	600
Total liquid in recuperator	9 pints
Allowance for leakage	1 pint
Total liquid in buffer cylinder and oil reservoir	15 pints
MISCELLANEOUS	Degrees
Maximum elevation	40
Maximum depression	5
Elevating gear, zero to	40
Traverse R. and L.	4
Turns of hand wheel per degree—	
Elevation	0·892
Traversing	2
One turn of hand wheel—	
Elevation	1·12
Traversing	0·5
Shipping tonnage	14 tons 36·75 cu. ft.

CHAPTER III

TRAILERS, ARTILLERY

A trailer is used in conjunction with the carriage to ensure flexibility of the load behind the tractor, and advantage is taken of this vehicle to carry ammunition and a number of small stores.

Two trailers, connected by means of the perch of the rear one, comprise the ammunition trailers of a section and are normally referred to as ammunition trailers, front and rear.

An identification lamp is attached to the rear of the trailer by pigtail clips.

NO. 27 ARTILLERY TRAILER

The No. 27 trailer can be employed either as the carriage trailer or as the front or rear ammunition trailer.

It has an ammunition box designed to carry 32 rounds in 16 trays, the box being provided with a locker for small stores and at the front is bolted a stores tray.

The ammunition trays are the No. 4 Marks II or IIA, each holding 2 fuzed shell and 2 cartridges.

The rounds should be placed in the trailer with the shell pointing towards the rear, as viewed when limbered up. This makes approximately 40-lb. difference in the weight on the point of the perch. (*See* page 161.)

The trailer consists of the following principal parts :—

Ammunition box—
- Trail bumpers

No. 227 special axletree—
- Axle bar
- Stub axle brackets

Wheels

Perch—
- Towing attachment
- Drawbar
- Bumper

Brake operating gear

The **ammunition box** is constructed of steel plate, the whole of which is welded together, excepting the front plate, which is riveted. The front plate and the doors only are of bullet-proof steel. The box, which is mounted on the axle bar, is prepared internally to receive the ammunition trays, which are supported on steel runners.

Two doors, supported on hinges, are provided at the rear, each being furnished on the inside with eight rubber pads, which are bolted in position to bear against the ammunition trays when the doors are closed. Rubber is inserted along the inside edges of the doors to ensure a tight fit and so exclude dampness. The doors are locked in the closed position by means of catches, which consist of a bar hinged to a bracket, the latter being riveted to the frame of the box. A locking lever, secured to a catch by a slotted nut, can be operated so that the catch is held by two small plates riveted to the door. To the top plate is secured a handle to assist in opening and closing.

To retain the doors in the open position, clips are welded to the upper hinge of the doors, which are caught and held by catches, consisting of small brackets with sockets for two hard steel balls, the brackets being secured to the stay of the trail bumper by U-shaped clamping bolts ; to prevent any vertical movement, the brackets are welded to the stay. The pressure on the steel balls is maintained by small flat retaining springs which are of sufficient strength to retain the clips when the doors are swung to the open position.

An inscription plate is riveted to the nearside door.

Trailers are illuminated in such a manner that they can be seen from behind without any light being visible from the air.

A locker is provided at the rear top centre, inside the ammunition box, for housing stores. It is closed by a hinged door, the rim of which has a packing of rubberised

felt to keep the locker watertight. A locking catch is fitted, being operated by a small hand lever.

A steel stores tray, with fittings, is bolted to the front of the box and conveys stores.

A narrow steel bar is bolted to the front plate of the box to retain in position a waterproof canvas cover with leather fittings, which fits over the stores tray to protect stores therein.

The cover is provided with brass eyelets to fit over hooks welded to the ammunition box and stores tray, the cover being finally drawn into position by means of lashing passed through the eyelets in the canvas and made fast.

Spring skids which project to the rear on each side, consist of a laminated spring with three leaves clipped together and an aluminium pad riveted at one end. The springs are clamped on the under side of the stub axle brackets by means of two plates, each with four bolts. As the rear of the trailer approaches the ground when raising the perch, the pads of the skids, coming in contact with the ground, will force the springs against small rubber buffers secured to the bottom frame of the ammunition box, thereby minimizing any possibility of damage.

A fuze-key plate is bolted to the bottom frame of the ammunition box at the rear.

Mudguards are positioned above the wheels and secured by bolts and nuts to the ammunition box, stores tray and to a plate welded to the box. They are provided at the rear with mohide mudflaps with strengthened edges.

Clips are provided on the mudguards for camouflage purposes.

Mudscrapers, of steel, are bolted to the brake drum covers and so shaped to avoid an accumulation of mud on the wheels.

The top of the ammunition box, at each corner, is fitted with a firing platform catch of steel consisting of a handle, hook, case, spring and large and small axis pins, for use with equipments that carry the firing platform on the trailer.

The handle pivots at one end on a large axis pin, and is also drilled to receive a small axis pin to which is attached the case. The hook fits in the case and at the bottom a nut is pinned. A spring is placed between this nut and a retaining nut which screws into the top of the case.

On lifting the handle, the case is raised and the spring relieved of compression, thus permitting the hook to grip the firing platform. On lowering the handle, the tension on the hook, caused by the compression of the spring, holds the platform in position on the ammunition box when travelling. A fitting is secured to the top of the box, on the offside, for the spare hub assembly.

The **trail bumper** consists of a vertical steel stay and two laminated springs, provided on each side at the rear of the ammunition box.

The top and bottom of the stay is prepared to take a spring, phosphor bronze bush and an end plate; the springs allow for a slight movement of the stay in the vertical direction. The plate is welded towards the bottom of the stay to prevent any turning movement and so avoid displacement of the locking catches which secure the doors of the ammunition box in the open position.

The upper and lower laminated springs have four and five leaves respectively, the leaves in both cases being of different lengths. Each spring is connected at one end to the stay by means of a slotted nut, spring washer and split pin. The other end is held between backing and clamping plates and secured by bolts and nuts to the frame of the ammunition box.

The **No. 227 special axletree,** of steel, consists of an axle bar and two stub axle brackets. The axle bar is positioned above the bottom plate of the ammunition box, whilst the stub axle brackets fit over the bar at each end, being secured by a bolt which passes transversely through the bar. In addition, the brackets are secured to the frame of the ammunition box by bolts and nuts. Angle stiffening plates welded to the side plates of the ammunition box are also secured to the bracket by means of a stud, with a buffalo hide shock absorber interposed. The brake drum cover plates and the stub axles, which form part of the wheel assembly, are each connected to the stub axle brackets by means of eight studs and nuts.

The **wheels** are identical and interchangeable with those described for the carriage on page 43.

As an interim measure, some trailers have been fitted with wheel hubs with plain bearings, in lieu of wheel hubs having roller bearings. Plain bearing wheel hubs will be identified by means of a white blob painted on the outside of the hub.

Trailers fitted with wheel hubs having plain bearings will, as far as possible, be retained for Home Service.

The **perch,** of steel, extends the full length of the trailer and consists principally of a tube in two parts, connected in prolongation, in front of the ammunition box, by flanges secured together by twelve bolts with slotted nuts and keep pins.

Part I of the perch is positioned in front of, whilst Part II passes through the centre of the ammunition box, being welded to the front and rear plates.

The brake operating shaft passes through the perch tube, being supported by internal bearing brackets, with bushes.

Part I is provided with front and rear flanges, the front flange being bolted to the flange of the drawbar and the rear flange to Part II.

A rubbing plate for the inner end of the perch bumper spring is secured to the under side of the perch tube by two screws with spring washers. The plate allows for spring expansion when the perch is lowered to the ground.

There are two lifting handles, left and right, at the front; each consists of an L-shaped arm of steel, the disc-shaped portions being secured to the under side of the perch by a bolt with a phosphor bronze bush to prevent wear. A diagonal-faced projection is formed on each handle to suit the locking catch on assembly. The two handles are connected by means of a return spring, the ends of which are attached to pins riveted to the handles.

Locking catches for the lifting handles are secured to small brackets on the perch tube by countersunk screws with spring washers and nuts. The catches consist of a housing, plunger, plunger spring, fulcrum pin, release lever and axis pin.

The housing is a steel casting, hollowed to take the phosphor bronze plunger with its spring. The plunger, which is bevelled at its lower end, comes in contact with the diagonal face formed on the lifting handle, whilst the upper end is connected to the release lever by a fulcrum pin, the release lever being also connected to the housing by an axis pin.

For lifting purposes, the handles are pulled out at right angles to the perch, thereby expanding the return springs; they are retained in this position by means of the locking catch plungers.

To return the handles to the travelling position, lift the release levers, thereby releasing the plungers, thus allowing the handles, with the help of the return spring, to rest against the front bracket for the perch bumper spring.

On top, at the front, is a stop case welded to the perch tube to take an operating brake stop (Fig. 54), which consists of a plunger with dome nut and two washers, plunger spring, handle, cover with two securing screws, and a stop pin.

The plunger, of steel, passes through the perch tube at the top and comes in contact with the face of the serrated sleeve of the perch eye stem. A dome nut with a plain and a spring washer intervening, secures an aluminium alloy handle with finger projections to the top of the plunger, the latter being kept up to its work by a spring which is compressed between a flange towards the lower portion of the plunger and the manganese bronze cover. The cover is secured to the case by two screws with spring washers and nuts. The words BACKING STOP are engraved on the cover. The stop pin, situated towards the top of the plunger, allows for a movement of the plunger through a quarter of a circle. The normal position of the operating brake stop is in the UP position.

Should it at any time become necessary to place the towing vehicle in reverse gear, the stop is lowered, bringing the plunger against the sleeve on the stem of the perch eye, thus preventing the trailer brake from being applied whilst moving in reverse. It is most essential that the stop is again lifted once the movement has been completed.

Part II of the perch tube is connected to Part I at the front by means of a flange and secured by bolts. It projects for a short distance at the rear of the ammunition box, to which angle pieces are welded.

Towards the rear, inside the ammunition box, a small recess is formed in the bottom of the perch tube to allow for the rear end of the brake gear operating shaft to connect with a crank lever supported on two vertical brackets.

The **No. 8 towing attachment hook** is secured to the angle pieces at the rear of Part II of the perch tube by means of four bolts with slotted nuts and split pins. The towing attachment is supplied with a catch with handles on each side, the catch pivoting on a fulcrum pin, a lubricator being fitted on the offside. An axis pin, retained by a split pin, connects the catch to an eye bolt with spring, positioned vertically behind the hook. The spring keeps the catch up to its work, its tension being maintained by a slotted nut at the lower end of the eye bolt.

The **drawbar** (Fig. 54) consists principally of a housing case, brake release lever, perch eye friction cap with bolts, two friction sleeves with springs, No. 27 perch eye with rotating limiting sleeve and distance piece, rotation limiting plunger with spring and sleeve, rotation limiting stop and two grease tubes.

The housing is a steel case connected to the front flange of the perch by six bolts with slotted nuts and keep pins ; it is shaped to fit inside Part I of the perch tube.

The brake release lever, of steel, is rectangular in shape, rounded at one end, with protecting toes which bear against the top of the perch eye friction cap. The lever is secured to the housing by an axis pin with plain washer and keep pin.

The perch eye friction cap, of steel, has an asbestos lining secured by two aluminium rivets ; the lining bears against the under surface of the perch eye stem. The cap is connected to the housing case by two securing bolts ; a sleeve fits over each bolt, over which springs are placed, the springs being held in position between the under surface of the cap and the flanges of the sleeves, a nut with spring washer maintains each spring in a state of compression. An asbestos lining, similar to that for the cap, is secured inside a projection on the housing case and bears against the upper surface of the perch eye stem.

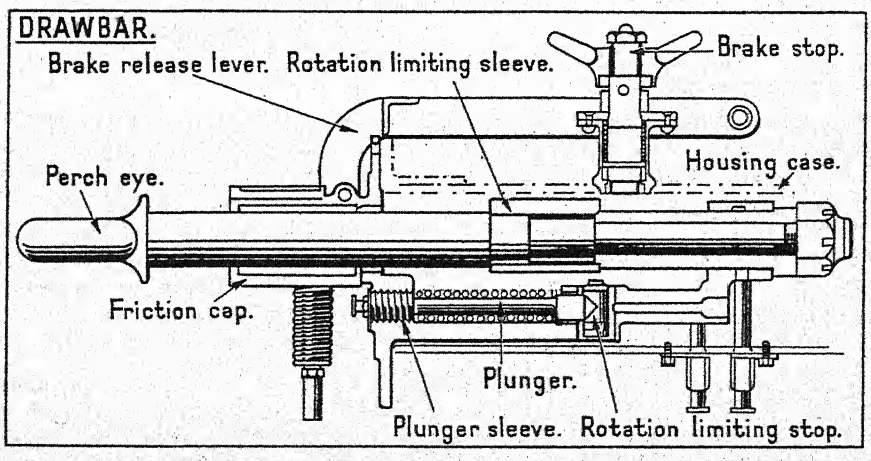


FIG. 54

THE ASBESTOS LININGS SHOULD ON NO ACCOUNT BE LUBRICATED, an instruction plate to this effect is attached.

The No. 27 perch eye, of steel, has a stem which passes through the housing case with an eye at its outer end. Towards the centre of the stem it is serrated to take a rotation limiting sleeve, which is also serrated. The sleeve has a flat surface which works in conjunction with a rotation limiting stop situated in a small recess

in the housing case. A phosphor bronze distance sleeve fits over the inner end of the stem, being held in position by a nut and keep pin.

A rotation limiting plunger, of steel, fits in a recess at the bottom of the housing case. The head of the plunger is fitted with a phosphor bronze bush, and is square in shape with a conical tip which fits into a V-shaped slot in the rotation limiting stop. A steel spring is placed over the plunger, the whole being secured in position by a gunmetal sleeve with lubricator, which screws into the housing and at the same time compresses the spring between it and a collar at the head of the plunger.

The rotation limiting stop, of steel, works in conjunction with the rotation limiting plunger and the rotation limiting sleeve. It is rectangular in shape, a V-shaped slot being cut on one side to take the tip of the plunger, whilst the top comes in contact with the flat surface of the sleeve when the perch eye is rotated. The stop is fitted with a phosphor bronze bush, and a grease retaining plate for the stop is positioned in a small recess at the bottom of the housing.

Two grease tubes with lubricators are held in position below the perch by means of two brackets with securing screws and spring washers. The longer of the two tubes is for the lubrication of the distance sleeve on the perch eye stem ; the shorter for the rotation limiting plunger and the stop.

The perch eye is allowed a rotary movement of approximately 35 degrees under normal conditions. When this position is reached the flat surface of the rotation limiting sleeve comes in contact with the top of the rotation limiting stop, thus preventing any further movement of the perch eye. Should the rotary movement of the perch eye exceed the normal amount, the pressure of the rotation limiting plunger against the side of the rotation limiting stop, together with the compression on its spring, should be strong enough to overcome any abnormal turning force exerted on the perch eye.

The **perch bumper** is a semicircular laminated spring, with four leaves of different lengths held together by means of two clips, each with a screw with nut. It is connected to brackets at the front of the perch tube by an axis pin which passes through a phosphor bronze bush, situated in the loop of the spring, the bush being fitted with a lubricator. The rear end of the bumper spring passes through a bracket on the perch tube, thus allowing for expansion ; to permit this, one leaf of the spring is rounded, to enable it to slide to and fro along the rubbing plate secured underneath the perch tube.

The **brake operating gear** consists of a system of braking operated from two positions. The brake can be operated by means of the perch eye being forced on to the brake operating shaft, when in the travelling position, or by means of a brake hand lever positioned on the nearside of the ammunition box. While the methods of applying the brakes are independent of each other, practically all the component parts are common to both.

The gear consists principally of a hand lever, release lever, ratch quadrant, cross-shaft, three cross-shaft brackets, operating shaft, crank lever, centre pull rod, three pull-rod levers, nearside and offside pull rods and two cam levers.

The **hand lever,** of steel, is keyed at its lower end to the cross-shaft, a phosphor bronze bush being interposed for which a lubricator is provided. A stop pawl as well as a ratch pawl is secured to the lever ; the former functions in a single slot on the top edge, whilst the latter functions in a number of teeth in the bottom edge of the ratch quadrant. A lug is formed towards the lower end which bears against the upper surface of the pull-rod lever on the nearside.

The **release lever,** of aluminium, pivots on an axis pin near the top of the hand lever ; another axis pin secures the lever to the release rod. The lower end of the rod is connected to the stop pawl and pawl link by a fulcrum pin, whilst the lower end of the link is connected to the ratch pawl and its spring by an axis pin. The pawl spring is attached at its lower end to a hook on the hand lever.

The **ratch quadrant,** of steel, is bolted to a cross-shaft bracket, being secured by nuts and spring washers. A number of teeth are cut on the lower edge for the ratch pawl, thus retaining the hand lever in the required position when operated. A single slot on the top edge, in conjunction with the stop pawl, prevents the brake from being prematurely applied due to vibration of the trailer when travelling.

The **cross-shaft,** of steel, passes from one side of the ammunition box to the other, being supported on each side and at the centre by brackets. A collar is riveted to the shaft against the inner surface of the nearside cross-shaft bracket, thus preventing any lateral movement of the shaft. Keys on the shaft at each end and the centre engage the keyways of the pull-rod levers.

The **cross-shaft brackets,** of aluminium, are bolted to the sides and centre of the ammunition box, each bracket being fitted with a phosphor bronze bush, which passes over the cross-shaft. The brackets are furnished with lubricators, whilst, in addition, there is a lubricating tube for the centre bush.

The **operating shaft** is a steel rod in halves, positioned on brackets towards the top of the perch tube on the inside. The front end bears against the perch eye stem, whilst the rear comes in contact with a crank lever.

The **crank lever,** of steel, has two arms, and pivots on an axis pin secured by a slotted nut and keep pin. The axis pin is fitted with a gunmetal bush, a lubricating tube with lubricator being provided for the bush. The lever is supported on its axis pin on two vertical brackets inside the ammunition box. The upper arm is operated by the movement of the operating shaft, while the lower arm is connected to the forked end of the centre pull rod by an axis pin. A small projection is formed on the lever at the bottom to which one end of a spring is hooked, the other end being connected to an eye. The tension of the spring can be adjusted by means of an adjusting nut at the rear face of the ammunition box.

The **centre pull rod,** of steel, is positioned vertically inside the ammunition box, being connected to the crank lever at the upper end and by a trunnion to the centre pull-rod lever at the lower end. For adjusting purposes, a No. 5 adjusting nut is screwed to the rod at the bottom.

The **three pull-rod levers,** of steel, are positioned at the centre, nearside and offside of the cross-shaft by means of keys and keyways, and secured in position by bolts with nuts and spring washers.

The **nearside and offside pull rods,** of steel, are connected to the pull-rod levers by their forked ends. The rods are provided with springs and lock nuts, the tension of the springs being adjusted by the lock nuts, and the brake by phosphor bronze No. 6 adjusting nuts with enlarged heads for handling purposes. The opposite ends of the rods are connected to the trunnions of the cam levers.

The **cam levers,** of steel, are connected at one end to the brake cams, whilst the other end connects to the pull rods.

Action of the overrun brake

When the trailer is attached to the towing vehicle the brake is automatically applied when travelling down an incline or if an abrupt halt is made, so preventing the trailer from tending to overrun the towing vehicle. This is accomplished by the trailer moving forward an inch or so, under its own weight, over the perch eye stem towards the towing vehicle. The stem bearing against the front end of the operating shaft forces the latter to the rear. The rear end of the shaft coming in contact with the upper arm of the crank lever forces it slightly to the rear, at the same time, the lower arm of the crank lever is drawn upwards, thereby transferring the motion to the centre pull rod and pull-rod lever, which partly revolves the cross-shaft and transfers the motion to the pull-rod levers at each end of the shaft. This ensures the brake being applied to both wheels simultaneously.

The pull rods draw the cam levers to the rear, thus operating the brake shoe cams inside the brake drums of the wheel hubs, causing the brake shoes to move about their fulcrum pins and to open out against the interior surface of the brake drums, thus applying the brake.

When the towing vehicle reaches level ground or starts after a halt, the pull is taken on the perch eye, so automatically releasing the brake. As the pressure on the brake shoes is released, return springs attached to the shoes compress and pull the shoes clear of the brake drums of the wheel hubs.

Should it be found necessary to release the overrun brake when the trailer is detached from the towing vehicle, the release lever is lifted upwards towards the perch eye. The toes of the lever force the perch eye friction cap downwards, thereby compressing its springs, and consequently releasing the pressure of the friction cap asbestos lining from the perch eye stem, thus allowing the perch eye to move to the front. The friction cap springs again reassert themselves when the pressure from the release lever is removed. The hand brake can now be applied independently of the overrun brake.

The return spring attached to the crank lever is to assist in releasing the brake when the brake is no longer required.

Action of the hand brake

The brake is operated by means of a hand lever on the nearside of the ammunition box.

On pulling the hand lever to the rear, the motion is transferred to the pull-rod levers and cross-shaft by means of the lug on the hand lever bearing against the upper surface of the near pull-rod lever. The pull-rod levers, together with the cross-shaft, are partly revolved, the levers bringing with them the pull rods and cam levers, thereby operating the cams and brake shoes as described for the overrun brake.

The pawl of the release rod, engaging the nearest tooth on the ratch quadrant, retains the brake in the ON position.

To release the brake, operate the hand lever to remove pressure from the pawl ; the latter can now be disengaged from the ratch by pressing the release lever, the hand lever is then operated in the same manner, being pushed to the front until the stop pawl engages the single slot at the top of the ratch quadrant. It is important that the handle of the brake must always be caught by the pawl stop engaging the slot in the ratch quadrant when travelling, otherwise the brake is liable to be applied by the vibration of the trailer.

Care and preservation

At the front of the perch is a drawbar, the asbestos linings of which, under the action of springs, bears on the perch eye stem ; a longitudinal movement of approximately 1½ inches is allowed for the perch eye when the brake is applied or removed. The asbestos linings should on no account be lubricated.

An operating brake stop engraved BACKING STOP positioned on top of the perch tube at the front, should normally be in the UP position, being lowered only when the towing vehicle is placed in reverse gear ; it is lifted again immediately the reverse movement has been completed. This allows for the perch eye, with the help of the release lever, to resume its normal position in relation to the hook of the towing vehicle.

To obtain the best service from the drawbar and its component parts, it is essential that the lubricators and tubes (Fig. 54) should be given frequent attention.

TRAILERS, ARTILLERY, NO. 27

WEIGHTS AND DIMENSIONS

	Gun Trailer	Section Ammunition Trailers	
		Front	Rear
WEIGHTS	cwt. qrs. lb.	cwt. qrs. lb.	cwt. qrs. lb.
Without stores and ammunition ..	18 1 21	18 1 21	18 1 21
With stores	20 0 15 (*a*) 19 3 21 (*b*)	19 0 17 (*b*)	20 1 23 (*b*)
With stores and ammunition	28 3 11 (*a*) 28 2 17 (*b*)	27 3 13 (*b*)	29 0 19 (*c*)
Pressure of perch—			
On ground—trailer loaded	1 2 7	1 0 15	1 0 15
On trailer hook—trailer loaded ..	1 1 14	0 2 0	0 2 0
DIMENSIONS	ft. in.	ft. in.	ft. in.
Length of perch	10 9	10 9	10 9
Width	6 11	6 11	6 11
Height	4 0	4 0	4 0
Wheel track—centre to centre ..	5 10	5 10	5 10
Greatest projection beyond wheel track	0 6½	0 6½	0 6½
Wheel tyre (inches)	9·00 × 16	9·00 × 16	9·00 × 16

(*a*) Includes jack, but without firing platform.

(*b*) Without firing platform.

(*c*) Includes spare hub assembly, but without firing platforms.

CHAPTER IV

MISCELLANEOUS STORES

ADAPTER, AIR PIPE, NO. 2

The No. 2 air pipe adapter is employed to connect one end of the charging pipe to the Mark I No. 1 pump adapter and the other end of the charging pipe to the Mark I No. 5 air pump. It consists of a gunmetal body in two parts. Part I is screw-threaded externally at one end to suit the pipe union and is formed hexagonal to take a spanner. At the other end the bore is enlarged and tapped to receive Part II, which is assembled with a union nut. The latter is screw-threaded internally to engage the pipe adapter or the air pump. Two adapters are required with each flexible charging pipe.

When Mark I* or II No. 5 air pumps and Mark II No. 1 pump adapter are used the pipe adapter is not required, the charging pipe being received direct by the pump and pump adapter.

ADAPTER, PUMP, NO. 1

The *Mark II* No. 1 adapter is used for connecting the pipe of the air pump to the air reservoir of the recuperator when charging. It comprises adapter, Parts I, II and III.

Part I, of steel, is 5¼ inches long and bored throughout its length to a diameter of 0·15 inch. One end is threaded externally to receive the pump pipe, whilst the other end is increased in diameter and threaded internally for attachment to Part III.

Towards one end a hexagon is formed for the application of a spanner and near the centre a boss is formed and bored to communicate with the central channel of the adapter, the boss being threaded internally to accommodate a No. 16 or 5 pressure gauge. A cap with washer is provided to blank one end when taking pressures with the pump disconnected, the cap being suspended on a chain.

Part II, of steel, is 2·65 inches in length and bored axially to a diameter of 0·15 inch. One end is threaded externally to form the means of attachment to the air reservoir of the recuperator, whilst the other end is enlarged and formed with a hexagon for the application of a spanner, being threaded internally for attachment to one end of Part III.

Part III is a rigid steel tube of uniform diameter, 21·5 inches in length and threaded externally at each end to accommodate Parts I and II of the adapter respectively.

Parts I and II are threaded and sweated on to their respective ends of Part III and each is finally secured by means of two fixing screws.

The *Mark II* adapter differs from the *Mark I* in that Part I is of gunmetal and prepared externally at one end to take the No. 2 air pipe adapter.

ADAPTER, PUMP, NO. 14

The No. 14 adapter, of steel, is 3½ inches in length and is for use with the No. 2 liquid pump for charging the H.P. cylinder ; a hexagon is formed towards one end to take an adjustable spanner. It is screw-threaded at one end for the attachment of the union of the flexible hose from the pump ; the other end is screw-threaded for insertion in the screwed recess of the filling hole of the recuperator. The interior is bored axially in two diameters for the passage of liquid.

APPARATUS, ILLUMINATING, AIMING POINT

The *Mark II* apparatus (Fig. 55) is designed to provide a suitable portable aiming point, capable of illumination, to facilitate laying the gun by night when no other arrangement is available. The light may be switched on or off as required from the gun position. The apparatus comprises a case, lamp and post.

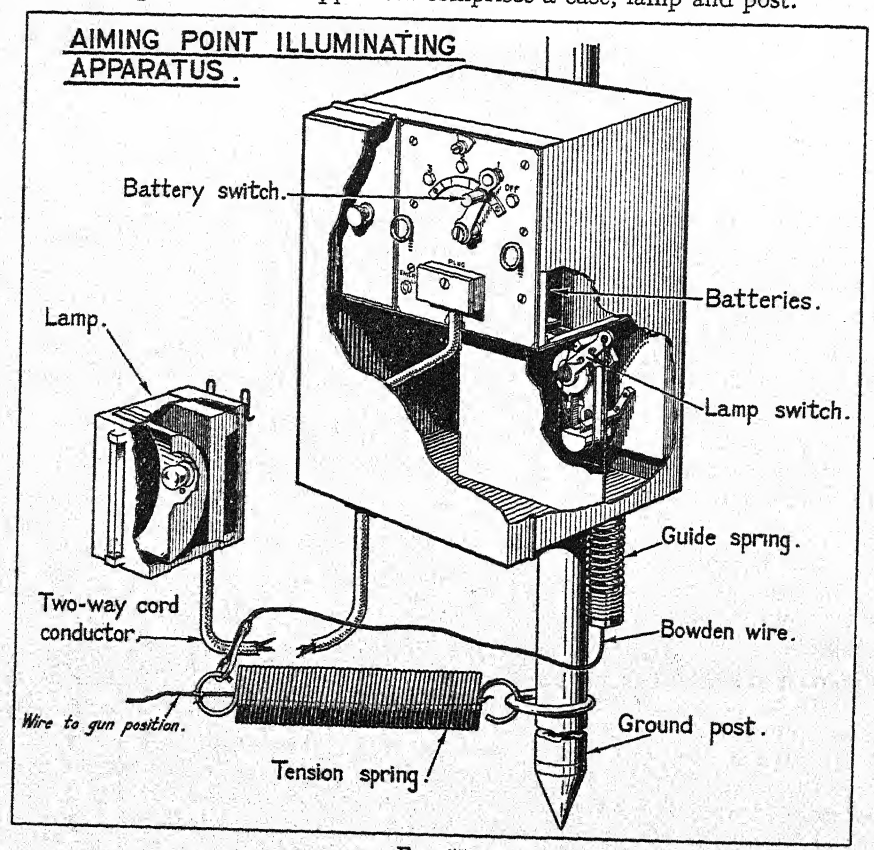


FIG. 55

The **case** is of tinned sheet-iron treated with service colour enamel and has a hinged front. When in use it is supported on an iron ground post, to which it is attached by two clamps with wing nuts. The lower end of the case has an opening to accommodate two bushes and a guide spring through which passes a Bowden wire for operating a lamp switch.

Four compartments are formed in the case, one of which contains three batteries, each comprising three Y dry cells, and a battery switch. The second compartment contains a lamp switch of the ratchet type, having an actuating lever to which the Bowden wire is attached by means of a spring hook, whilst the remaining two compartments contain a lamp with 30 feet of two-way conductor cord and spare parts respectively. All three batteries are connected to the battery switch, which ensures that only one battery is in use, whilst the other two form a reserve, the position of the switch indicating when the current is off or whether the 1st, 2nd or 3rd battery is in use. The panel which carries the battery switch has an emergency link connection, for use when the lamp switch is out of action, and two sockets to take the two-pin plug of the two-way conductor cord.

The lamp switch is provided with a short lever to which is attached one end of a Bowden wire, the other end being attached to a loop on a tension spring attached to the ground post. A spiral spring returns the lamp switch to the normal position when the lamp is no longer required.

The **lamp** is carried in a tinned sheet-iron box treated with service colour enamel; a lid is provided and coated on the inside with white enamel. It is fitted internally with a 3·5-volt P bulb held in a socket to a reflector base, to which is fitted a semi-circular trough shaped reflector. Two terminals on the base form a means of attachment of one end of the two-way conductor cord, the other end being plugged to the panel of the battery switch. A glass strip is fitted into an aperture in the lid from which comes a thin pencil of light. The top of the box is provided with a hook by which it is suspended to the aiming point or post.

The **ground post** is an iron pipe about 3 feet long, pointed at one end and plugged at the other; a tension spring, carried on the back of the case when not in use, is provided with a loop at each end, one of which passes over the ground post, whilst to the other is attached one end of the Bowden wire. A suitable length of telephone cable, or similar substitute, by which means the apparatus is operated from the gun position, is also attached to the outer loop of the tension spring, passed through the coils of the spring and finally attached to the ground post, leaving the wire slack between the two points of attachment, to permit the spring to extend when a pull is exerted. The object of the tension spring is to prevent damage to the lamp switch as the result of a direct or violent pull.

Preparation for use

The ground post is driven firmly into the ground, a loop of the tension spring is passed over the post and the case is secured to the post by means of the two clamps. Open the lid and remove the lamp box and conductor cord from the case. See that one end of the Bowden wire is attached to the lever of the lamp switch and pass the other end through the hole and guide spring at the lower end of the case, and finally connect it to the outer loop of the tension spring. The operating cord from the gun position can now be attached to the tension spring and post as previously described. Insert the plug of the two-way conductor cord into the holes of the battery switch panel marked PLUG and move the switch to the appropriate number according to the battery it is desired to use. The lamp box is now attached to the aiming post or point it is intended to use. Ascertain that all connections have been properly made and that the apparatus is functioning correctly.

Action

When it is desired to illuminate the aiming post or point, the end of the operating cable at the gun position is pulled. This operates the lamp switch and closes the

circuit, causing the bulb filament to become incandescent. When no longer required, a second pull on the operating cable, breaks the circuit. The spiral spring on the lamp switch and the tension spring on the post return the lever and cord to the ready position each time.

APPARATUS, ILLUMINATING, SIGHTS, NO. 5

The No. 5 apparatus (Fig. 56) is provided to illuminate the range indicator, sight clinometer and No. 7 to 7C, 9 or 10 dial sight in order to facilitate laying by night, and consists principally of a battery box carried on the carriage, from which three cables carry the current to lamps clipped in a convenient position to each of the three fittings previously mentioned.

The case is of mild steel; it is provided with a folding front and lid, and has accommodation for the battery box, leads and lamps, which are all retained in the case, with lid and front closed, when the apparatus is not in use. Two spring clips are provided for lampholders.

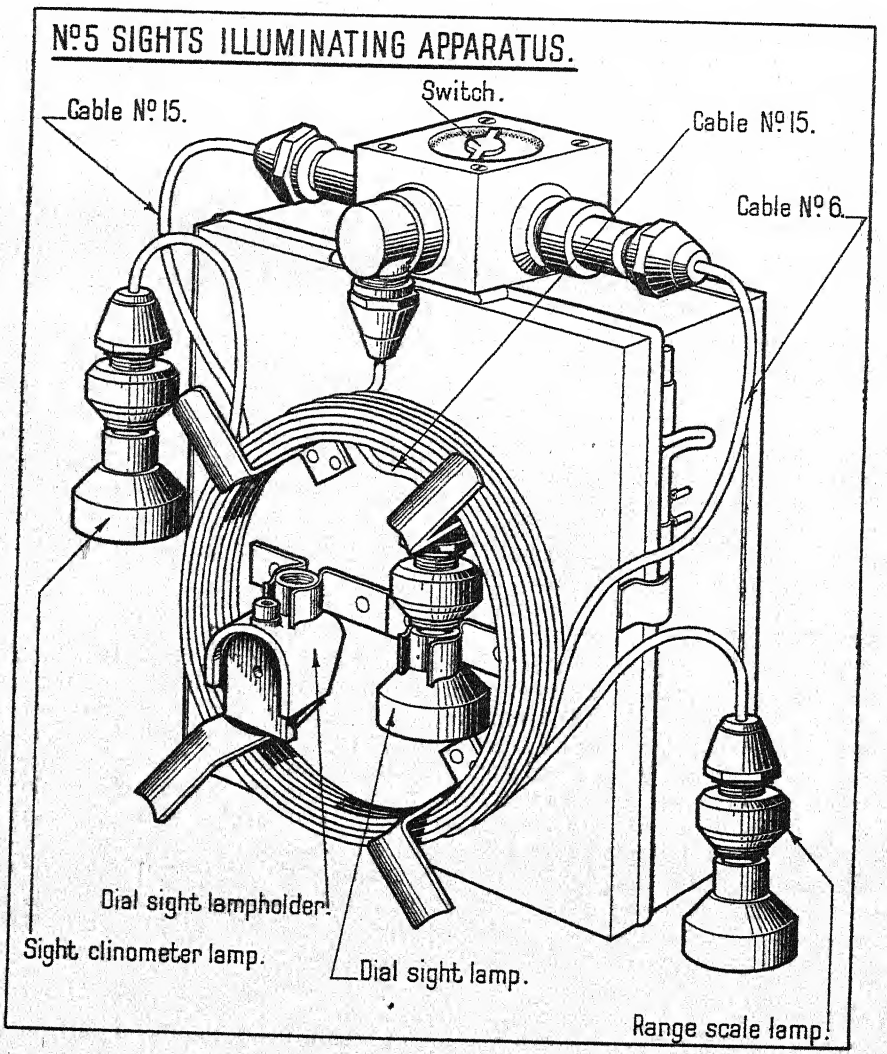


FIG. 56

The battery box is of tinned-plate and contains three W dry cells (Q inert cells at stations abroad) connected in series, and held together by three rubber bands. It is secured to the case by a strap and the lid is fitted with a switch for turning the current on or off. On the front of the box four hooks form a drum round which the cables can be wound when not in use; there are two centre lamp hooks to accommodate a lampholder and dial sight lamp.

The three cables are of the flexible, aluminium-armoured type, and are fitted at the end with the lampholders and lamps; they are clipped to the carriage and shield in suitable positions. Each cable is marked on the grip nut with two numbers; that on the hexagon portions signifying the number of the apparatus with which the cable is used, and that on the tapered portion the number of the cable.

No. 6 cable goes to the range indicator.

No. 15 cable goes to the dial sight.

No. 15 cable goes to the sight clinometer, and may also be used as a wandering lead.

APPARATUS, PULLING BACK GUN, NO. 7

The apparatus (Fig. 57) is used in conjunction with the Mark II No. 3 quick release attachment and an 8-feet 10-inch wire rope. It is of the "Nimrod" type.

The apparatus consists principally of a ratchet bar, drag shoe, operating lever, connecting link, anchor chain and hauling chain.

The **ratchet bar** is a steel bar, tapered at one end to facilitate entry through a drag shoe and bent upwards at the other end and drilled to receive the securing pin of a shackle and swivel eye. Its upper surface is formed with teeth which engage a fulcrum pin which is secured to an operating lever and a pawl.

The **drag shoe** is a rectangular-shaped casting which is hollowed to fit over the ratchet bar and recessed in one of its sides to secure the links of a hauling chain. A hole is bored through its upper surface for the reception of the pawl, two projections being formed which engage the pawl crosshead and retain it clear of the teeth of the bar, when required.

The pawl is a steel, spring-loaded bolt, chamfered at its lower end to engage the teeth of the rack and screw-threaded at its upper end to receive the securing nut. Below the screw-threaded portion it is formed square to receive a crosshead. Just above the chamfer is formed a flange against which the spiral spring bears. A hole is bored transversely through the shoe, through which passes the axis pin of the connecting link.

The **operating lever** is a steel lever, 5 feet in length, the upper end of which is formed circular for ease of handling. The lower end is forked and fitted with a fulcrum pin to engage the teeth of the bar. Just above the forked portion, a hole is drilled to take an axis pin of the link.

The **connecting link** is a small steel bar having a hole drilled at each end, one to take the axis pin of the operating lever, and the other the axis pin which secures it to the drag shoe.

The **anchor chain** consists of 4 feet of ½-inch standard chain with a special end link.

The **hauling chain** consists of 2 feet of chain similar to the anchor chain and is provided with a steel hook.

Method of use

The method of attaching the anchor chain to the trail is shown on Fig. 57.

(*a*) Thread the long length of wire rope through the bore from the breech end and pass a stout spanner through the splice at the muzzle end.

(*b*) Attach the anchor chain to the trail eye as indicated and the quick release attachment to the shackle of the wire rope.

(*c*) Lift the pawl and lever and push the drag shoe along the ratchet bar to the front end; re-engage the pawl.
(*d*) Pull on the hauling chain and engage one of the links in the recess in the drag shoe.
(*e*) Push the operating lever to the front to engage the pawl in the bar teeth. By pulling the operating lever to the rear, the fulcrum pin of the lever engages a tooth of the bar and hauls the drag shoe to the rear and with it the hauling chain, quick release attachment and wire rope, and, through the medium of the spanner, the gun and cylinder block, the pawl engaging a tooth, so preventing the gun from running back.
(*f*) Pushing the lever forward engages a fresh tooth and the operation is repeated until the gun is about one foot to the rear.
(*g*) Allow the gun to run-out by releasing the quick release attachment, using the clip.

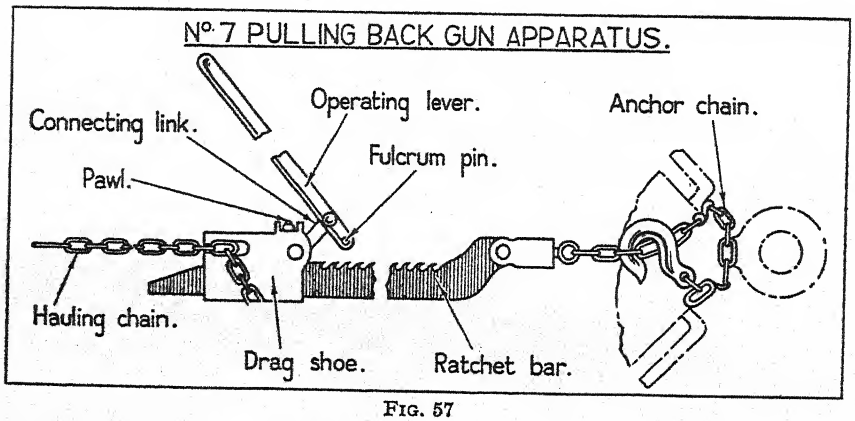


FIG. 57

ATTACHMENT, QUICK-RELEASE, NO. 3

The *Mark II* No. 3 attachment (Fig. 58) is for use with the No. 2 pulling jack or No. 7 pulling back gun apparatus. It consists of a hauling chain shackle, and a steel loop in two parts, each part having one of its ends hinged together on the hauling-shackle bolt, whilst the opposite ends are kept closed by a U-shaped clip with hinge pin on Part I, which passes over Part II. Upon knocking the clip rearwards the parts fly open, releasing the attachment from the shackle of the long wire rope, thus permitting the gun to run out.

The hauling chain shackle is attached to the hauling chain of the jack or No. 7 pulling-back apparatus, the latter being attached to the rear of the trail by the 4-foot anchoring chain.

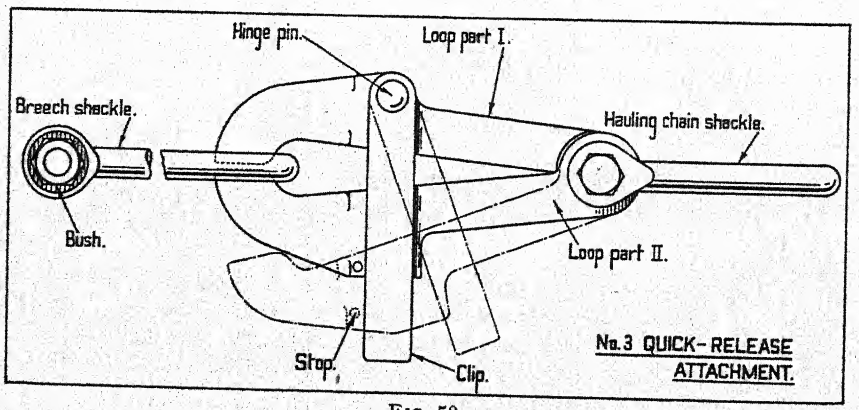


FIG. 58

BOX, CHARGING PUMPS

The *Mark II box*, which is of wood, is strengthened by steel angle plates and has, secured to the bottom, two wood strips to seat the box on the trailer. The lid is covered with canvas and provided with two steel hinges. It is fastened by means of a steel turnbuckle and hasp.

Four leather loops, with buckles, are provided on the back; the upper two secure the handle of the air pump, and the lower two secure the Mark II No. 1 pump adapter. A leather loop is provided at each end, to be used as handles or for securing the box to the trailer.

Internally the box is provided with a tray and suitable fittings, lined with Fearnought, to carry the air pump, liquid pump and screw-acting hand pump, together with the pressure gauge, No. 2 air pipe adapter, No. 2 adapter, spanners, etc.

The overall dimensions of the box are: length 24 inches, width 16½ ins., depth 13½ inches, and the weight, when packed, 3 qrs. 19 lb.

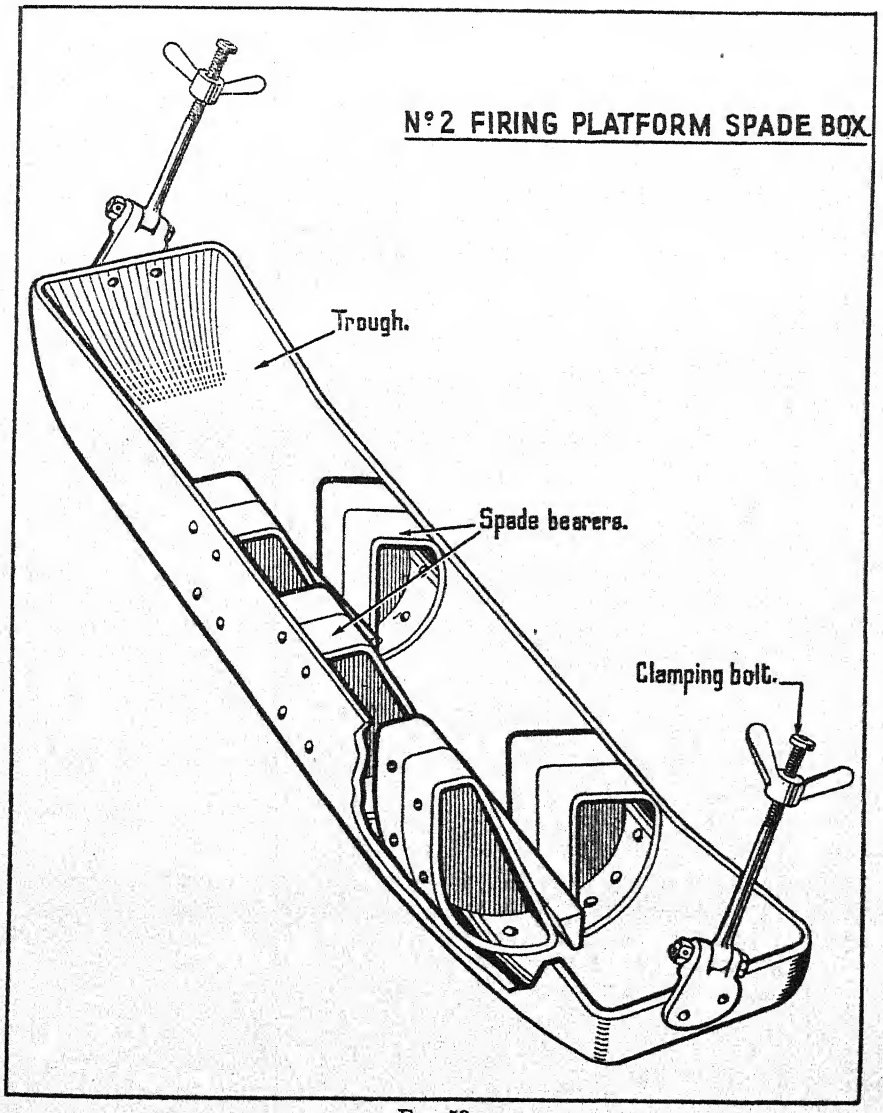


FIG. 59

BOX, SPADE, PLATFORM, FIRING, NO. 2

The box spade (Fig. 59), of steel, is used in conjunction with the No. 9 firing platform and is placed over the spade blade to prevent the blade entering the ground and so allow the trail to be rapidly traversed for anti-tank shooting.

It consists of a trough, of nickel steel, shaped to form a receptacle for the lower end of the trail spade. Left and right bearers as well as a centre bearer are riveted to the trough to strengthen it and also serve as bearing surfaces for the spade. Four drain holes are provided to release any water that may have entered.

A clamping bolt bracket is riveted to each side of the trough. It is formed with projections which are bored for the reception of a bolt, the bolt being secured by a slotted nut and keep pin.

Two clamping bolts are provided to secure the spade box to plates riveted to the trail. The bolts are bored at their lower ends to engage with the bolts of the clamping brackets, whilst the top portion is screw-threaded for 2 inches for a winged clamping nut which forms the means of attachment for the spade box. Collars are riveted over the extreme ends of the bolts to prevent the clamping nuts from falling off.

CAP, SPONGE, NO. 6

The cap is of waterproof canvas and provided at one end with a draw string. It is shaped to cover the No. 18 piasaba brush or the No. 1 wool cleaner.

CLEANER, PIASABA, NO. 18

The cleaner consists of a brush composed of piasaba or kittool bristle fixed in the middle portion of a 1-inch white hemp lanyard. A 1·5-inch diameter lead ball is attached to one end of the lanyard so as to carry it through the bore of the gun. The lanyard is knotted at one end to prevent loss of the ball, whilst the other end is made into a loop.

Alternative materials may be used in the manufacture of the head portion of the brush. Nylon, treated with a water resistant, in lieu of piasaba, and bakelite in lieu of brass or wood.

Total length of lanyard is approximately 18½ feet.

CLEANER, WOOL, NO. 1

The wool cleaner is generally similar to the piasaba cleaner previously described, from which it differs principally in having a wool sponge instead of a brush.

CLINOMETER, FIELD

The field clinometer is designed to permit it being quickly set to any required graduation.

The *Mark VI* clinometer (Fig. 60) consists of the following parts: body, arm, plunger, slider and bubble case, all being of gunmetal.

The **body** has two plane surfaces, at right angles to each other. A transverse hole is bored for the pivot of the arm, opposite which is a toothed arc, each tooth representing 1 degree. Both sides of the arc are graduated in degrees, on one side from 0 to 44 degrees, on the other from 45 to 89 degrees, an arrow on the side of the plunger acting as an index. The surface which forms the base of the clinometer is marked with an arrow to indicate the direction of the target, and with the words USE THIS BASE FOR 0° TO 45°. The second surface has an arrow indicating direction of target, together with the instruction 45°–90°. The upper portion of the body is slotted longitudinally to permit observation of the bubble when the arm is set at angles between 35 and 55 degrees.

The **arm** along which the slider with bubble moves is pivoted to the body. The arm is curved slightly, so that, as the slider moves away from the pivot, the axis of the bubble is placed at an increasing angle to the base of the clinometer, the total movement being equivalent to 1 degree. The arm is graduated on each side from 0 to 60 minutes, reading in opposite directions, and is bored from the outer end to take the plunger and spring. A small slot on the under surface, in conjunction with the stop screw of the slider, limits the movement of the latter.

The **plunger** has a spindle and head in one piece. The spindle portion fits in the arm, against a spiral spring; the head is rectangular, with teeth to engage the arc on the body. Side plates are fixed to the head on each of which an index is engraved for the degrees scale ; they are roughened and project on each side of the arc.

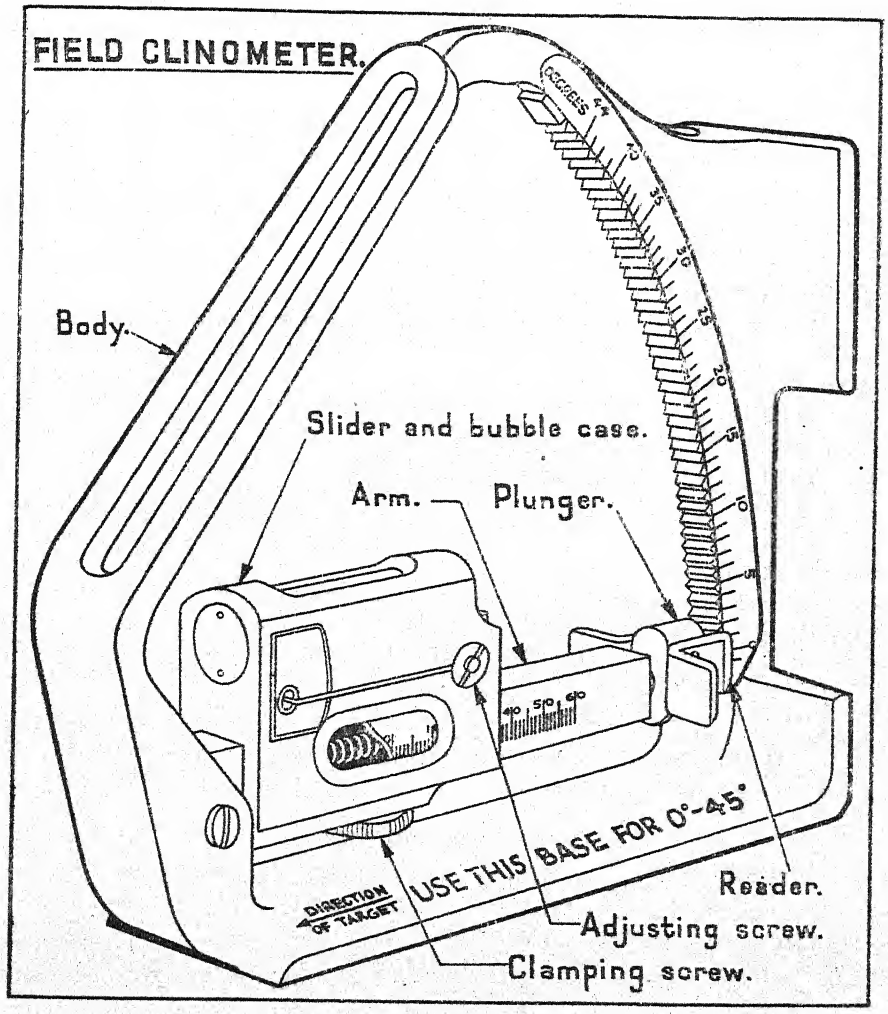


FIG. 60

The **slider and bubble case** is rectangular in shape and divided into upper and lower portions by a saw-cut. The solid end is towards the pivot of the arm, the open ends being connected by the adjusting and clamping screws. The upper portion is bored longitudinally for the C glass spirit bubble, the upper surface being partly

cut away to expose the lines on the bubble. The ends are closed by caps. The lower portion is prepared to slide along the arm and has slots on each side to expose the minute graduations, which are read against an arrow. A clamping screw with milled head and a stop screw is fitted to the under side, whilst a flat nickel-silver spring lies between the slider and arm. The slider can be clamped to any position on the arm by the milled headed clamping screw.

The graduations on the instrument are filled in with black wax; some parts of the body are nickel-plated, others are enamelled black.

The *Mark V* differs from the *Mark VI* in the form of slider and bubble case. The case is a separate fitting and is secured in the slider by end caps. Three adjusting screws support and secure the bubble case at its inner end.

The *Mark IV* differs from the *Mark V* in the graduation of the arc and slider, these being similar on both sides, i.e. 0 to 44 degrees on the arc and 0 to 60 minutes on the arm. No instructions are engraved as to how to place the instrument on the plane.

The *Mark III* differs from the *Mark IV* in the method of attaching the bubble casing to the slider. The case is pivoted on trunnions at one end and is supported on a capstan-headed screw at the other, which provides the means of adjustment. The upper portion of the body is not slotted.

In all Marks suitable provision is made for effecting the necessary adjustments to eliminate index error.

To set the clinometer

Press in the plunger and move the arm until the reader on the plunger is opposite the required graduation on the degree scale. Release the plunger, unclamp the clamping screw and move the slider until the arrow on it is opposite the required graduation on the minute scale. Clamp the slider. The degree and minute scales on the same side of the clinometer must always be used in conjunction.

To test and adjust the clinometer

See pages 143 and 151.

To use the clinometer

Great care should be taken to see that the clinometer plane is clean and free from grit, paint, etc.; that the instrument is placed in the same position every round, and that it is correctly set and the elevation adjusted, so that the bubble may be in the same place each round. The layer's eye should be in the same position relative to the clinometer for each round. When laying, it is convenient to bring one end of the bubble tangenital to a line on the glass, provided care is taken always to use the same line. When testing for index error, or when adjusting the clinometer, the bubble must be brought to the true centre.

CONTAINER, FUZE NO. 1

The *Mark I* fuze container is intended to be carried in the No. 27 trailer and is designed to contain three No. 210 time fuzes each in a No. 101F cylinder. (The Mark IX cylinder cannot be used in the container.) The fuzes are provided for air burst ranging.

The container consists of a body, packing disc, retaining handle and hinge wire.

The **body** of tinned plate, is cylindrical and is closed at one end. The felt packing piece is inserted into the body and is situated at the closed end.

The **retaining handle,** of steel wire, is fitted to the open end of the container and serves to retain the cylinders in position. It is hinged to the steel hinge wire which is secured around the open end of the body by the edge of the body being rolled over it. Two slots, diametrically opposite, are provided in the body, in rear of the hinge wire, to afford clearances for the handle.

The hinged portion of the handle is situated in the lower of the slots whilst a portion, in the form of a catch, fits inside the upper slot when the container is closed.

The handle is retained in the closed position by a spring locking grip which is hinged to the hinge wire at one end and fits around the catch at the other.

In order to extract a cylinder from the container, the grip is released from the catch by a combined downwards and sideways movement ; the catch is thus pressed downwards until clear of the slot and the handle pivoted outwards on the hinge pin.

COVERS—BREECH AND GEARS, 25-PR., CARRIAGE
MUZZLE, NO. 23, MARK IA OR NO. 49
GUN AND CARRIAGE, 25-PR., MARK I
SIGHT, 25-PR. CARRIAGE

The covers are of waterproof canvas and suitably shaped to enclose the fittings they are designed to protect.

When in position the breech cover envelopes the whole of the breech fittings. The muzzle cover originally had a ruby reflector positioned centrally with the bore of the gun ; when not in use the reflector was covered by the canvas flap.

The fittings of reflectors to muzzle covers has been discontinued.

The gun and carriage cover protects practically the whole of the working parts of the gun and carriage from dust and grit due to mechanical traction, lashings being provided to secure the cover in position.

When fitted with a muzzle brake a No. 49 cover is provided.

EJECTOR, PROJECTILE, Q.F. 25-PR.

The ejector consists of a wood stave in two parts, joined by a manganese bronze socket with locking screw. The head of the ejector is of manganese bronze and is riveted to one end of the stave. It has two bearing surfaces, one for H.E. and smoke streamline shell, and the other for A.P. shot.

GAUGE, PRESSURE

The **No. 16 gauge** (Fig. 61) consists of a brass casing closed in rear by a steel plate and in front by a graduated dial with protective cover of perspecs. Attached to the bottom of the case is a metal bearing, the lower part of which passes through the case and is threaded to fit in the adapter. A hexagon is formed above the threaded

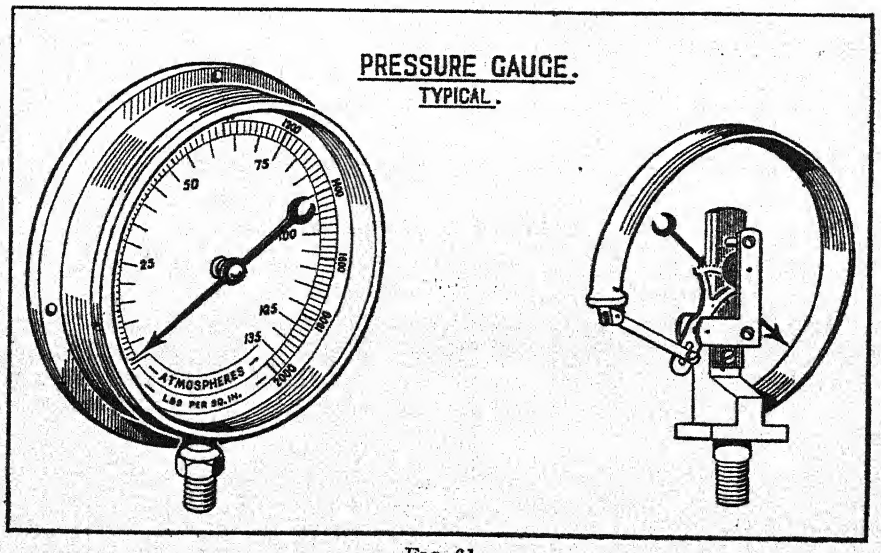


FIG. 61

portion to take a spanner for screwing the gauge into position. The upper end of the bearing is prepared inside the casing to support the remaining parts of the gauge mechanism. A hole, bored longitudinally through the bearing, leads through a diagonal channel within the casing, to the fixed end of a curved copper tube of oval section. The other end of the tube is closed and pinned to a short steel arm. The latter is fixed to an adjustable arm attached to a segmental rack which gears with a pinion on the spindle of the dial indicator. A pointer on the spindle indicates the graduations on the dial face.

A hair spring is fitted on the spindle to ensure positive engagement with the toothed segment. The dial is graduated with two scales, the outer being designed to register pressures up to 2,000 lb. per square inch ; the inner, atmospheres up to 135. The outer scale is graduated in black, the inner scale in red. A stop is fitted to the indicator to prevent movement of the pointer below zero.

The **No. 5 gauge** differs from the *No.* 16 in being designed to register pressure up to 900 lb. per square inch and the atmospheres up to 60.

Action

Pressure being admitted through the bearing to the interior of the curved tube of oval section, the latter tends to straighten itself, the amount of such straightening motion varying directly with the pressure admitted. The closed or free end of the tube, therefore, rotates the segmental rack and through it the pinion, spindle and pointer, the latter indicating the amount of movement (and therefore the degree of pressure) on the dial face. On the pressure being shut off from the gauge, the curved tube takes up its normal position, and the pointer, through the gearing, is returned to the stop.

GAUGE, STRIKER PROTRUSION, NO. 16

The No. 16 gauge is a small steel plate having one edge cut to indicate the high and low limits of protrusion 0·09 inch to 0·11 inch. The plate is so made as to gauge the protrusion of the striker from the face of the breech block. The protrusion should lie between the limits of the gauge.

HANDSPIKE, 25-PR. CARRIAGE

The handspike consists of a steel tube which is plugged at one end by an aluminium alloy plug, the plug being rounded and secured by a rivet. The other end of the tube is heated and shrunk on to an end piece which is finally secured by riveting.

The end piece is shaped so as to fit into brackets on the trail, where it is locked in position for lifting purposes.

A steel collar is riveted towards the centre of the handspike.

IMPLEMENTS, AMMUNITION

The **holder, cartridge, Q.F. 25-pr.** consists of a circular steel band which encircles the cartridge case, terminating at each end in long handles. The inner surface of the band is slightly tapered to suit the cartridge case with which it is used, whilst inserting or removing the percussion primer.

The **holder, shell, Q.F. 25-pr.** consists of a hinged ring of steel, having two handles, which is provided with a bolt and winged nut for tightening the holder around the shell.

Key, No. 34 (Fig. 62), of steel, is used for inserting or removing No. 1 percussion primers in the cartridge case. It is cranked to fit over the rear of the cartridge case, and has two steel pins screwed into the cranked portion, which engage in the slots in the primer. The key is fitted with a lanyard.

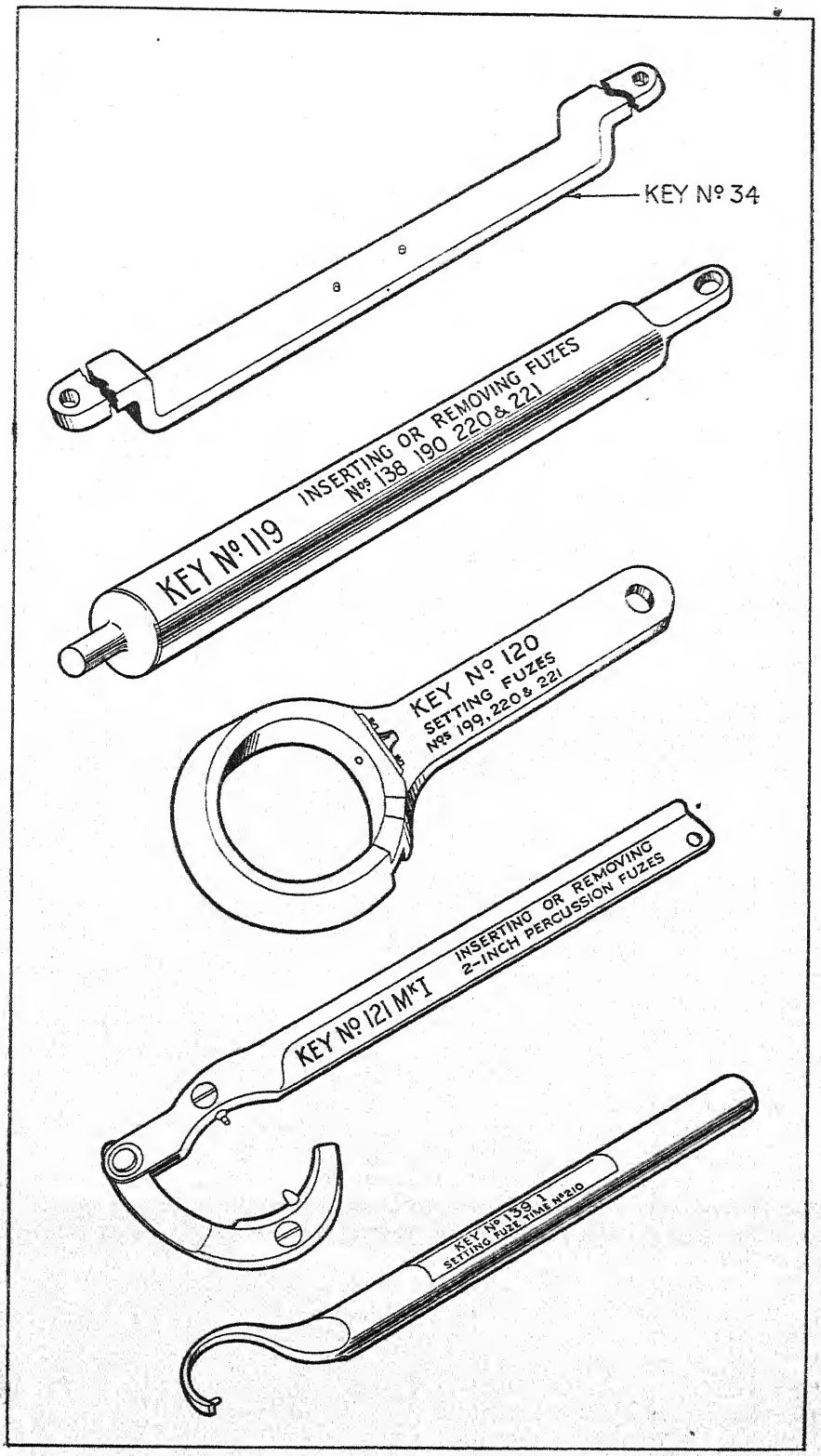

KEY Nº 34
KEY Nº 119
INSERTING OR REMOVING FUZES
Nos 138 190 220 & 221
KEY Nº 120
SETTING FUZES
Nos 199, 220 & 221
KEY Nº 121 MK I
INSERTING OR REMOVING
2-INCH PERCUSSION FUZES
KEY Nº 139 I
SETTING FUZE TIME Nº 210

FIG. 62

Key, No. 119 (Fig. 62), consists of a steel rod with a projection formed at one end to engage the keyhole in the fuze. The opposite end is flattened and provided with a hole for a lanyard. The key is used for inserting or removing Nos. 220 and 221 fuzes.

Key, No. 120, Mark I (Fig. 62), of steel, has a handle with a ring portion, the end of the handle being drilled through to receive a lanyard. The ring portion is bevelled to suit the contour of the fuze, slots being cut in the upper and lower edges near the handle to enable the graduations on the fuze to be read. A stud, retained by a flat spring in a recess in a ring over the centre of the handle, engages with the setting slot in the time ring of the fuze. The key is used for setting Nos. 220 and 221 fuzes.

The Mark I* key is the Mark I converted by substituting a steel securing strap for the flat spring.

The Mark II has a new pattern stud piece which is provided with two holes for securing screws. A centre projection on the stud piece forms the setting stud.

Key, No. 121 (Fig. 62), consists of a steel lever which forms the handle, and a hinged clamp. The inner edges of the lever and clamp are bevelled and shaped to the 2-inch percussion fuze, each edge being fitted with a projecting pin secured by a set screw. Instructions are stamped on each side of the clamp indicating which side is used for the insertion and removal of fuzes. A hole is bored in the end of the lever to accommodate a lanyard. The key is used for inserting or removing 2-inch percussion fuzes.

Key, No. 139 (Fig. 62), consists of a steel bar approximately 8½-inches in length and is C-shaped at one end and fitted with a stud for setting the No. 210 time fuze. The opposite end is chamfered and provided with a hole for the attachment of a lanyard.

Key, No. 180, consists of a flat steel bar formed at one end with a tapered ring which is provided with a viewing slot in the side. The ring is drilled through above the handle and fitted with a stud secured by two screws. It is used for setting fuze No. 222.

JACK, LIFTING, SCREW, 2½ TONS

The screw jack (Fig. 63), of steel, is designed to give a powerful lift in a small space, being 6½ inches in height when fully closed. It comprises an inner and outer sleeve each giving a lift of 4 inches, the total height of lift being 8 inches. In addition, the inner sleeve has a screw which carries the head and can be screwed out to the extent of 4 inches before taking the weight, to make the initial adjustment under the weight to be lifted.

The inner sleeve is square in section to prevent rotation and has an internal screw thread for the screw and head. A ring is secured at the lower end by two dowel pins; it is screw-threaded on the outside to engage the V-threads of the interior of the driving bush.

The driving bush, of brass, is formed at its upper end with a flange and internally with a right-hand V-screw thread and externally with a left-hand square screw thread. A stop ring at its lower end is secured by a set screw.

The outer sleeve is a plain cylinder in which is formed two feathers diametrically opposite each other on the exterior and terminate a short distance from the lower end, so forming a stop.

The sleeve is closed at its upper end by a cap which is flanged and secured to the sleeve by four grub screws. The flange is screw-threaded internally to receive a screwed ring by which the driving bush is retained to the cap but allowed rotation.

The screwed bush is between the driving bush and outer sleeve, the upper end of which is cut internally with a square thread to engage the exterior of the driving bush. The lower end is secured to the worm wheel by screws.

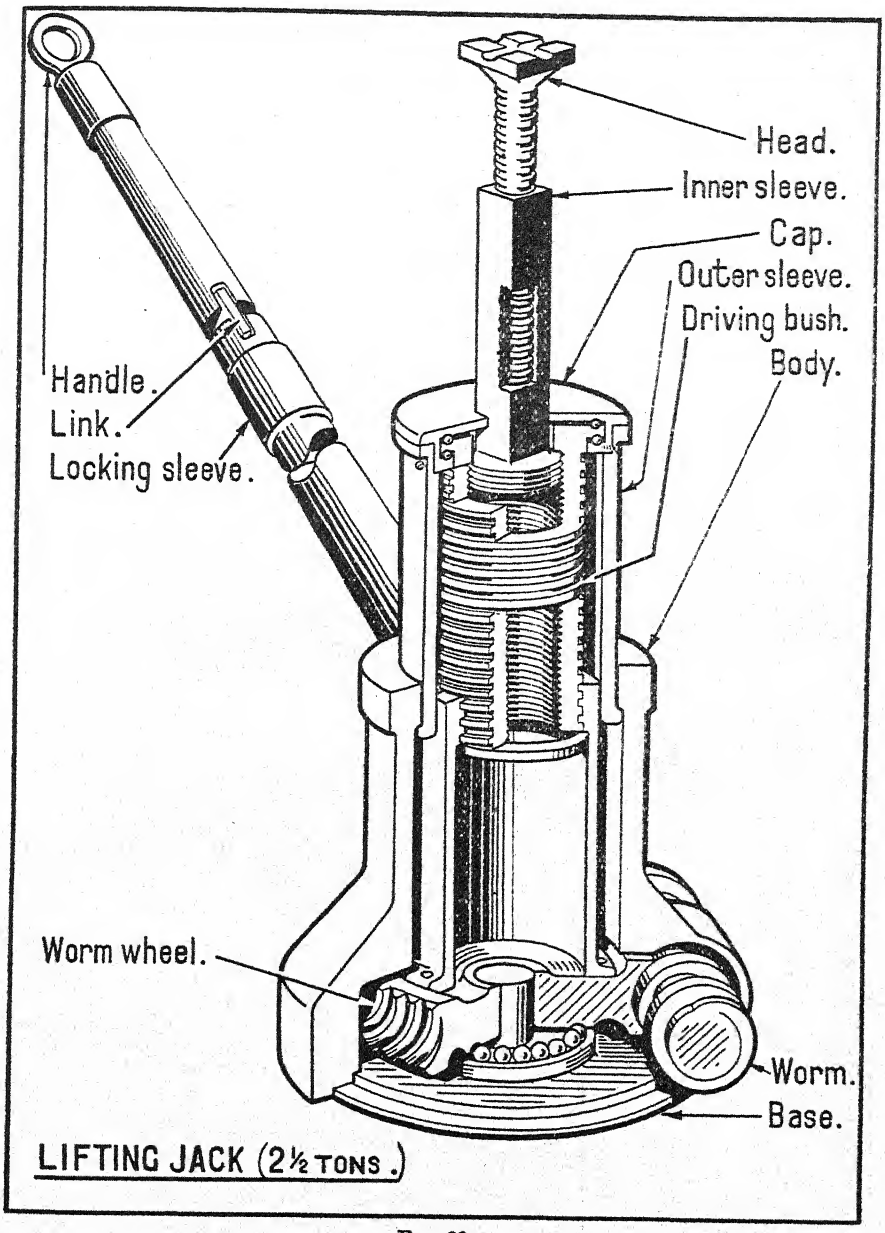


FIG. 63

The worm wheel is formed with teeth on its periphery and a ball racer on the lower edge, whilst the screwed bush is secured to its upper surface.

The whole is contained within the body by a base plate on the upper side of which is formed an anti-friction ball racer. The balls are interposed between the racer and worm wheel.

The worm and worm spindle have anti-friction balls at each end to reduce friction, the spindle having a locking cap to lock the handle to it.

The handle is in two parts, hinged together by a link, and is 3 feet 6 inches in length. A loop and two brass bushes are formed at one end, a sleeve being placed between the bushes.

A steel sleeve is free to slide over the hinged portion at the centre to make the two parts rigid. A coupling is formed at the other end of the handle to suit the recess in the worm spindle, where it is retained by a locking cap.

Action

Rotation of the worm by the handle causes the worm wheel and screwed bush to rotate, forcing the driving bush against the cap, so raising the outer sleeve. This movement is continued until the feathers on the body reach the lower end of the feather-ways in the outer sleeve. As the driving bush cannot go any higher it is forced to rotate with the screwed bush, causing the inner sleeve to rise, rotation of the inner sleeve being prevented by its shape.

In lowering, the reverse action takes place.

JACK, PULLING, NO. 2

The No. 2 pulling jack (Fig. 64) is designed for pulling back the gun, and is used in conjunction with the Mark II No. 3 quick-release attachment.

The jack consists principally of a ratchet block, operating lever, 4-foot anchoring chain and a 15-foot hauling chain.

The **ratchet block,** of steel, comprises a ratchet wheel and two cheeks; the wheel is mounted on a spindle held between the cheeks by nuts and keep pins; it is grooved and recessed to conform to the chain links, a chain guide being riveted to one of the cheeks. A shackle connection is bolted between the cheeks at the top shoulder of the block, which contains a ratchet catch (consisting of a plunger, plunger springs and lever). The catch holds the ratchet when the lever is shifted, but the plunger is disengaged by the catch lever to allow a free run for the chain. A lever link is bolted to the bottom shoulder of the block.

The **operating lever** is forked at one end, and is fitted with two fulcrum pins; the inner one to connect with the lever link and form a movable fulcrum, and the outer pin to engage and move fresh teeth on the ratchet.

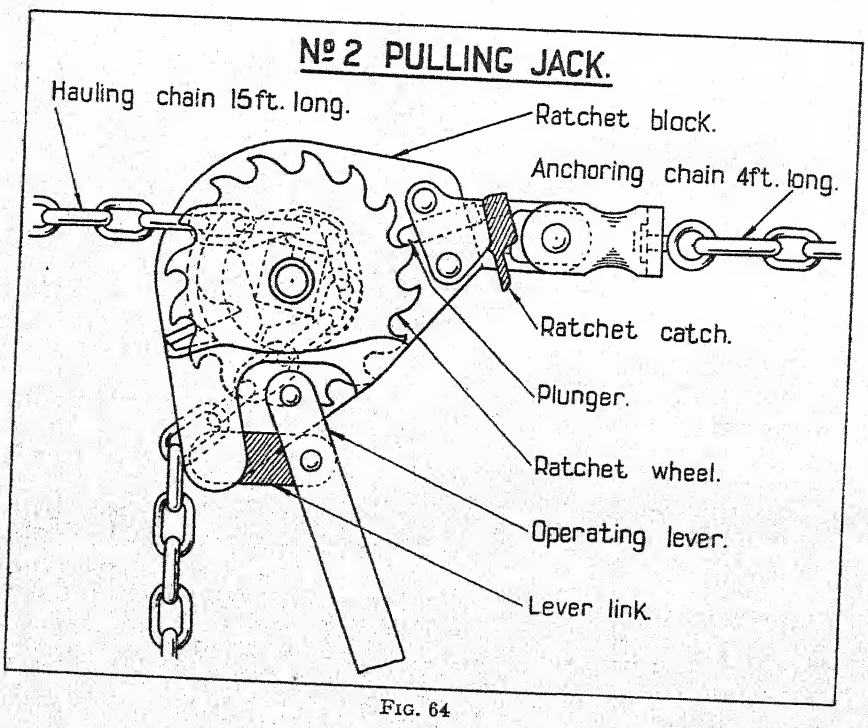


FIG. 64

The 4-foot **anchoring chain** is secured at one end to the shackle connection by means of a shackle with swivel bolt and pin. The other end is provided with a hook for attachment to the trail of the carriage.

The 15-foot **hauling chain** is provided at one end with a loop, and at the other end with a swivel link and hook, for connecting to the hauling chain shackle of the No. 3 quick-release attachment.

To use the jack

(*a*) Thread the long length of wire rope (as used with the pulling back gun apparatus) through the bore, placing a stout spanner or iron bar in the loop at the muzzle end.
(*b*) Connect the steel loop of the quick-release attachment to the shackle at the breech end of the long rope.
(*c*) Connect the 15-foot hauling chain of the jack to the hauling chain shackle of the quick-release attachment.
(*d*) Connect the 4-foot anchoring chain to the rear end of trail as shown in Fig. 57.
(*e*) Pull back the gun about a foot or so by operating the lever of the jack.
(*f*) Allow the gun to run out by releasing the quick-release attachment, using the clip.

The spring-loaded plunger in the jack is not used for this purpose, but is for convenience in adjusting the anchoring chain when attaching it to the trail; it also serves as a ratchet pawl when the lever is shifted.

KEY, M.V. CORRECTOR SCALE READER

The key is used in connection with the sight for clamping and unclamping the M.V. corrector scale reader.

KEY, REMOVING, JAMMED Q.F. CARTRIDGE, NO. 1

The *Mark II* key is of steel, approximately 10 inches long. One end is threaded and shaped to the same external dimensions as the No. 1 percussion primer, whilst the other end is flat and formed with two studs which fit into recesses in the primer. Towards the threaded end it is provided with a cross handle and near the flat end a boss is formed and recessed to receive a tommy for use as a lever when withdrawing the cartridge case.

Use

The percussion primer is unscrewed from the jammed cartridge case by means of the studs on the flat end of the key. The key is then reversed and the threaded end fully screwed home into the base of the cartridge case. The case can now be levered out of the chamber with the aid of a tommy.

LANYARD, COCKING, NO. 4

The *Mark I* lanyard consists of a galvanized steel wire rope, 15 inches in length, fitted at one end with a steel hook and at the other with a wood toggle.

The *Mark II* lanyard differs from the *Mark I* in being manufactured from white tarred line instead of steel wire rope, and in having a loop formed at the end in place of a steel hook.

The lanyard is of sufficient rigidity to enable the operator to affix the hook to the cocking handle of the firing mechanism whilst standing clear of the recoil of the gun.

LINKS, CONNECTING, FIRING PLATFORM

The *Mark I* No. 1 connecting links (Fig. 65) are for use with the No. 9 firing platform and consist of a crossbar, 2 platform stays, 2 locking links, 2 locking pawls, 2 springs, 2 trail stays, 2 connecting bars and 2 connecting eyes.

The **crossbar** is a steel arm, bored at the centre to pass over the pivot and secured by a nut and keep pin. Each end of the arm has screw threads for a connecting link, which is secured by a castle nut and keep pin.

The **platform stays,** left and right, are steel forgings, one end being cranked and bored to pass over the crossbar and the other forked and bored to receive the short connecting bar. The forked ends are cranked to suit the locking links, whilst a small projection on the outside of the upper surface forms a stop against the connecting links. A locking pawl fits between the lugs of the fork.

The **locking links,** left and right, contain the locking pawls and form the means whereby the connecting links are folded in the centre to allow the carriage to run over the platform without the necessity of detaching the stays from the trail.

The locking links consist of a link, pawl, pawl cam pin, lever and spring.

The **links,** of steel, are cranked and bored at the front and rear ends to receive the short and the long connecting bars respectively. A small projection is formed on the inside at the extreme rear end to act as a stop against the upper surface of the forked end of the trail stays. Another projection is formed on its upper surface, in front of the boring for the long connecting bar, which is bored and screw-threaded for the securing screws of the spring. An elongated rectangular hole is formed between the hole at each end for the tubes, to receive the pawl, whilst two holes are bored vertically through the link, the one at the front for the pawl cam pin and the one at the rear is screw-threaded for the axis pin of the pawl.

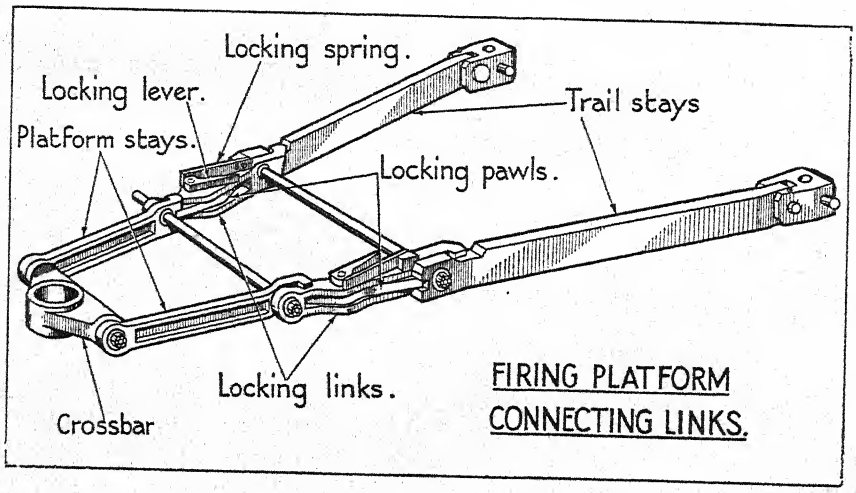


FIG. 65

The **pawls,** of steel, are formed with a toe at each end to enter the forked ends of the connecting link and trail stay, so making the three sections of the stays one unit. A hole is bored in the centre for an axis pin, whilst another hole towards the front end is elongated for the eccentric of the pawl cam pin. The toes at each end are chamfered for ease of entry into the forked ends.

The **pawl cam pins** have hexagons at their upper ends for the attachment of the locking lever and a flange to bear in the upper surface of the locking links, the lower end being screw-threaded for a castle nut and keep pin. The centre part of the pin is set off to form an eccentric to actuate the pawl.

The **locking levers,** of steel, operate the pawl and retain it in and out of action by means of two flats formed on the periphery of its boss ; a small lever manipulates the pawl cam pin. The boss, at its centre, is formed hexagonal for the attachment of the pawl cam pin, which is secured by a rivet.

The **springs,** of flat steel, press against the flats formed on the locking levers, thereby retaining the pawl in one of the two positions. They are secured by two screws to the projection on the locking link.

The **trail stays,** left and right, consist of a small and large forked end and a connecting tube.

In future manufacture the trail stays will consist of a solid rod formed integral with the forked ends.

The **small forked end** is screw-threaded at the rear end to take the front end of the connecting tube and bored laterally at the front end for the long connecting bar. The rear toe of the pawl fits between the forked portion, thereby holding the stay rigid.

The **large forked end** is screw-threaded at the front end to take the rear end of the connecting tube, the forked end being bored laterally for attachment to the connecting eye by a pin which is secured by a split pin.

The **connecting tube** is screw-threaded internally at each end for the reception of the forked ends.

The **connecting bars,** long and short, maintain the connecting links at the correct distance apart and form the hinges about which the various sections pivot. They each consist of a tube with an end piece screwed to each end.

The tubes differ only in length, except that the shorter one has a cylinder nut at the right in the form of a handle. This handle is positioned so that the personnel of the detachment can assist the trail in opening out the stays.

The **connecting eyes** are in the form of two loops at right angles to each other; the pintle on the trail is attached to one loop, whilst the large forked end is attached to the other.

PIPE, CHARGING, NO. 2

The *Mark II* pipe consists of a length of copper tubing, having the ends soldered into sleeves and provided with union nuts. A leather packing washer is fitted to each union nut to make an airtight joint.

The pipe is shaped to suit the particular carriage with which it is used.

The *Mark I* differs from the *Mark II* in being made of $\frac{1}{4}$-inch duplex flexible tubing of copper. Great care must be exercised in the general handling and packing of the Mark I pipe, which must not be coiled beyond the limits of flexibility, i.e. less than 12 inch diameter.

PLANE, TESTING, CARRIER, NO. 7 TO 7C DIAL SIGHT

The plane (Fig. 66), which is of cast-iron, is formed to provide two clinometer rests on its top surface. The rests are at right angles to each other, so that a clinometer may be used on the plane, either at right angles or parallel to the axis of the piece. Two parallel lines are inscribed on each of the rests; the correct position for the clinometer is between these lines.

The stem, with a slotted nut on the under side of the plane, is generally similar in shape and dimensions to that of the supporting pillar of the No. 7 to 7C, 9 or 10 dial sight, and fits into the socket of the dial sight carrier; a projection on the plane, similar to that on the dial sight, fits into the recess on the top of the carrier, so preventing the plane from turning in the socket.

The plane is for use in conjunction with a clinometer for testing the sight carrier for verticality and the cross-level bubble for accuracy of position.

When not in use it is contained in a box provided with a leather strap handle for carrying purposes.

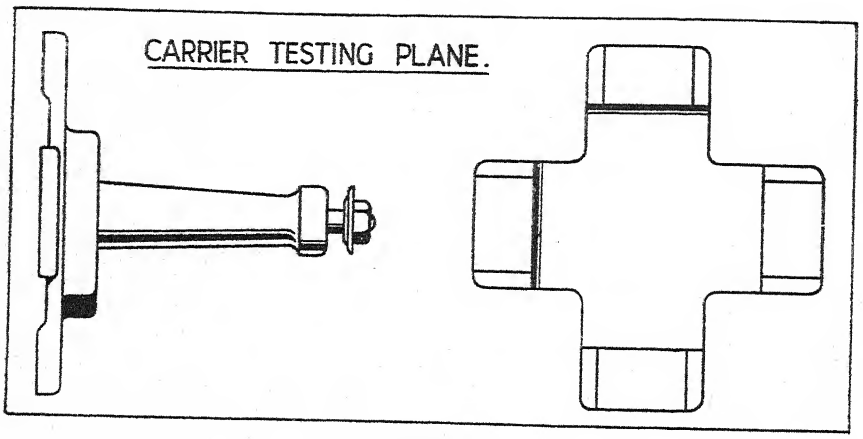


FIG. 66

PLATFORM, FIRING, NO. 9

The platform (Fig. 67) is in the form of a wheel with a flange projecting upwards the diameter of which is the same as that of the track of the carriage wheels. It is carried under the trail and when required is lowered to the ground and the carriage is hauled over it to the rear, so allowing rapid all-round traverse for anti-tank shooting. To prevent the spade becoming embedded, a box is placed over it, so allowing easy traverse over the ground.

The platform consists principally of a rim, and connecting links consisting of crossbar, platform stays, locking links, connecting bars and connecting eyes.

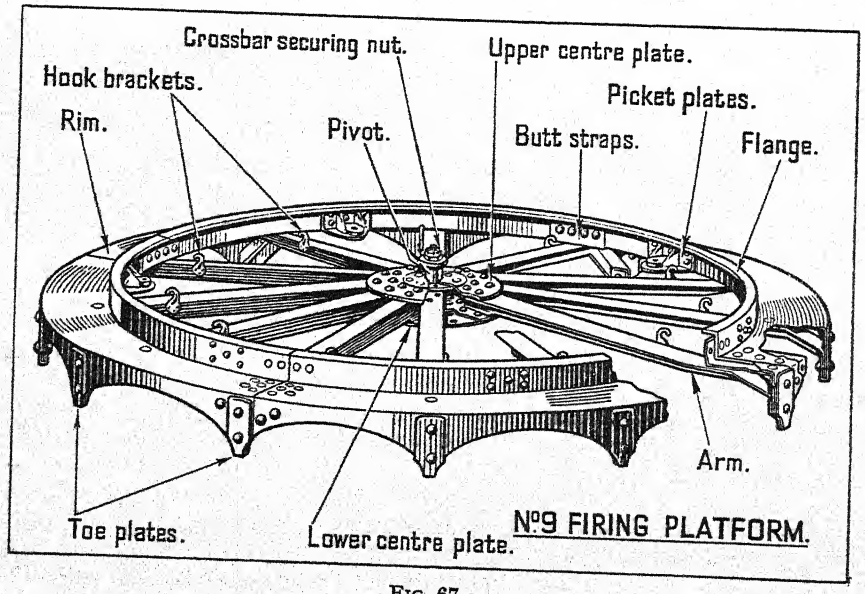


FIG. 67

The **rim** is made up of four quarter plates, quadrant-shaped and riveted together to form a circle by means of butt straps. Twelve arms, eight long and four short, radiate from the centre, where they are secured by rivets to circular upper and lower centre plates.

The outer ends of the arms are riveted, the short ones to the butt straps and the long ones to the quarter plates, each arm having a toe plate riveted to it and to the rim. The toe plates bite into the ground and, in conjunction with an all-round flange projecting downwards on the rim, prevent movement of the platform during firing. Welded to the upper side of each arm, near the rim, is a hook bracket to receive the lifting chain.

Riveted to the flanges of the centre plate is a pivot which is provided with a screw thread at its upper end for the crossbar securing nut.

Riveted to the upper surface of the rim and projecting towards the centre are six plates which are prepared for the reception of pickets. They are riveted in between every other arm.

A flange is formed on the upper surface of the rim the same diameter as the track and is graduated with an all-round degree scale in multiples of a degree. The scale is painted white on a black background and is read by a pointer secured to the carriage. No figures are painted on, but it is intended that they should be chalked on to suit the site of the battery position.

In view of widespread damage which has occurred to the No. 9 firing platform, particularly during heavy barrage firing, the platform is to be strengthened by stiffening pieces (Fig. 68). As a temporary measure, to reduce the risk of damage

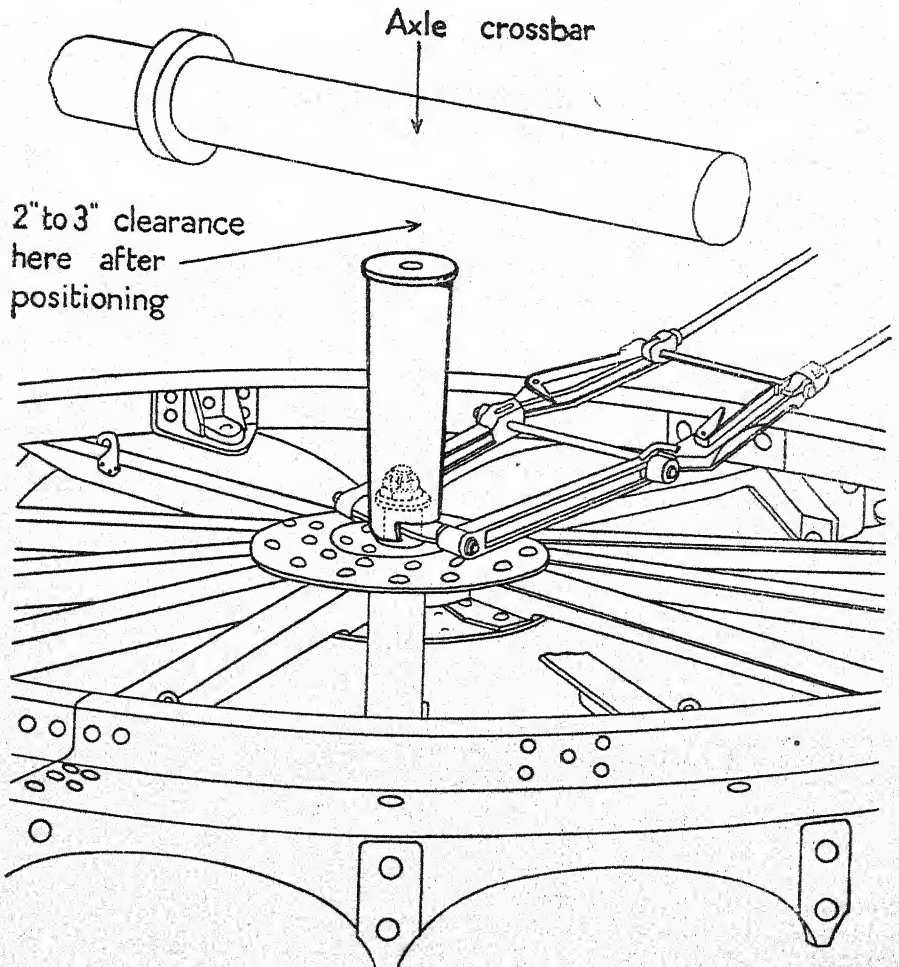


FIG. 68

to the platform when firing, a strut, manufactured from a fired 25-pr. cartridge case, will be fitted between the firing platform and the axletree, as in Fig. 68. Partial removal of the radius on the crossbar may be found necessary in order to fit the strut.

It is important to establish the clearance shown in Fig. 68 as, if the axle is in contact with the strut before firing, downward dishing of the platform will result. The strut will be removed when it becomes excessively damaged. It is anticipated that exchange will be necessary after 350 to 400 rounds (Charges II, III and super). Struts will be removed for travelling.

The cartridge cases used for this purpose will, wherever possible, be those that are unsuitable for reforming, e.g. cases having damaged lips or rims.

Care and preservation

To minimize casualties to equipment and consequent buckling of its rim and fracture of the spokes, a picket will be driven into the ground about 8 feet in front of the gun, and the platform made fast to it by means of a wire rope passed around the hub, over the side spokes and under the rear spokes as depicted in Fig. 69.

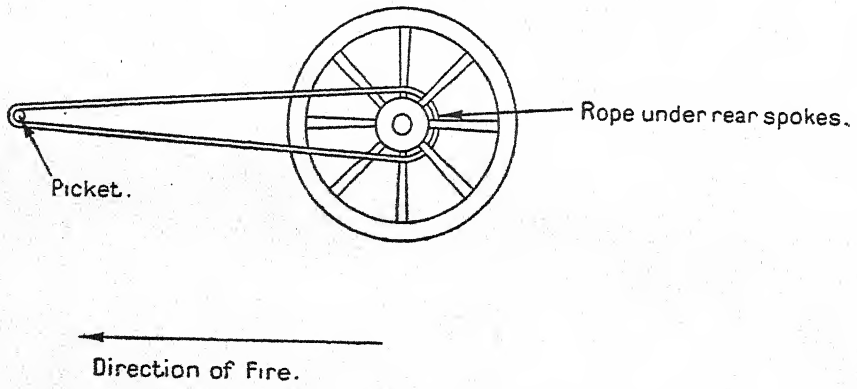


FIG. 69

During prolonged action in one position, the gun should occasionally be run clear of the platform, which should be turned through 45 degrees to distribute the strain evenly over the spokes and rim.

To facilitate repainting of the platform, brass boss-head rivets are inserted to indicate the position of each 10-degree graduation.

POST, AIMING, CROSSHEAD, NO. 1

The aiming post (Fig. 70) is designed to admit of the gun being re-layed accurately for line, without altering the original position of the aiming posts, when the carriage has moved slightly in a lateral direction whilst in action. It is provided with a cross-head which can be clamped in any convenient position on the stem. The head is either circular or square, one gun of a section having circular-headed posts and the other square-headed to avoid confusion when laying.

The *Mark III* post consists of the Mark II circular head, or square head, stem with a Mark III crosshead.

The **Mark II stem** is of solid steel throughout, the top being enlarged for the use of a hammer to enable it to be driven into hard ground. A step is screwed to the stem and secured by a rivet, while the bottom is spiked to facilitate entry into the ground. A steel backing plate to take the head is riveted to the stem close to the upper end. The diameter of the circular head and sides of the square head are each 3 inches in length.

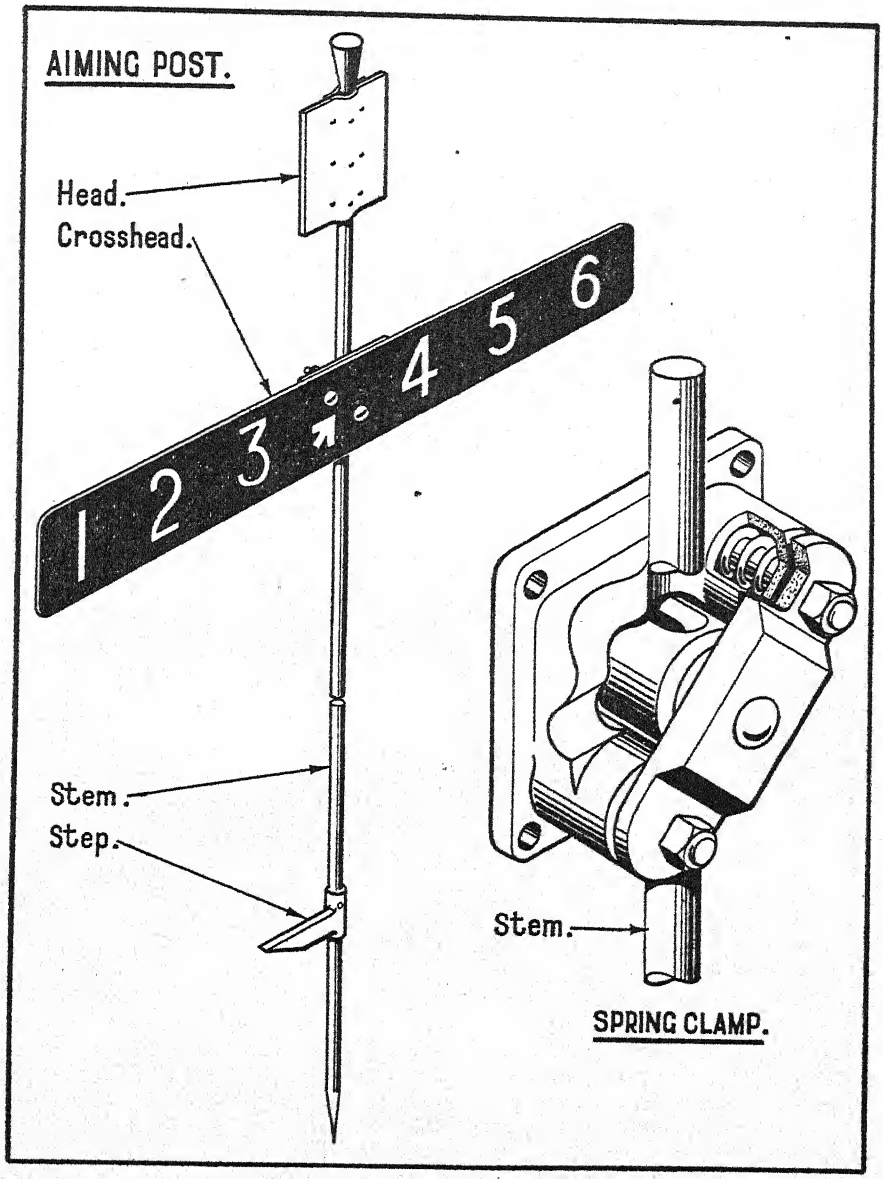


FIG. 70

The **Mark III crosshead** is of the single arm type, secured to the stem by a spring clamp. The latter facilitates adjustment of the crosshead for height and enables the aiming post to be folded in the travelling position. It is retained in the folded position by a clip, riveted on the crosshead, engaging the stem.

A white painted arrow head, in the centre of the crosshead arm, enables the layer to gauge the correct position for the crosshead when being moved up or down the stem. The figures 1 to 6 are also painted on the crosshead at equal intervals.

The approximate dimensions are, total length 54 inches, crosshead 26 inches.

Normally the sights are aligned on the stem. Should the carriage move to the side slightly, the sights are aligned on the same number on both posts as found convenient.

PUMP, AIR, TWO-STAGE, HORIZONTAL, NO. 5

The **Mark II pump** (Fig. 71), which is provided for charging the recuperator system with air in cases of extreme urgency, is of the horizontal, two-stage type, and consists of the following principal parts :—

Compressor body.
Piston with bush and packing rings.
Forked lever with fulcrum pin and driving handle.
Four valves.
Low-pressure chamber cover.
High-pressure chamber cover.
Dust covers.

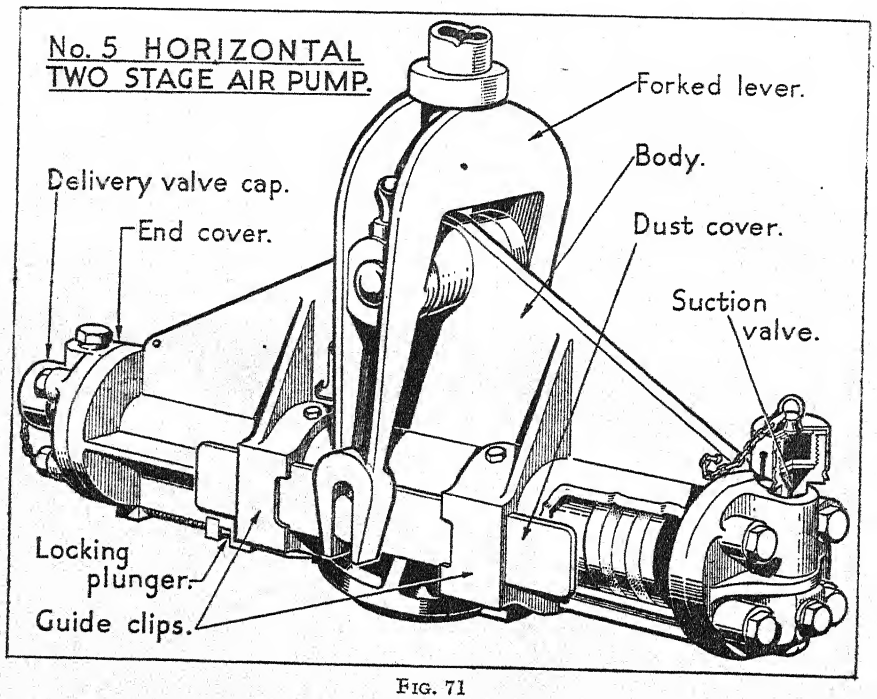


FIG. 71

The **compressor body,** of cast iron, is formed with high and low-pressure chambers, in which operates a packed piston. The pressure chambers, which communicate with each other through a copper pipe lying longitudinally on the pump, are closed by means of gunmetal covers, in which are fitted the valves. The body is furnished, on the under side, with a locking bolt with spring and trigger, by means of which the pump is locked in the saddle on the trail.

The **piston,** of steel, is in the form of a double ram. The enlarged end of the piston, which works in the low-pressure chamber, is provided with two packing rings ; the other end, of smaller diameter and working in the high-pressure chamber, is similarly provided. The packing rings are cup-shaped leather rings.

The piston is actuated by means of a gunmetal forked lever pivoted about its centre on a steel fulcrum pin which is held in position by a stop peg and carried in bearings at the top of the compressor body ; the upper portion of the forked lever is formed with a socket to receive the tubular steel handle ; the lower portion is connected to the piston by means of a steel crosshead pin.

The **valves** are of the non-return type and are interchangeable ; each consists of a steel ball valve, spring and plug. Two are fitted in each cover.

The **low-pressure chamber cover** is fitted with a suction and delivery valve; the suction valve is furnished with a strainer protected by a cap, which also prevents ingress of foreign matter.

The **high-pressure chamber cover** is fitted with an inlet and delivery valve and furnished with a connection for the charging pipe, by means of which the pump is connected to the recuperator. When not in use, the connection is closed by a protective cap secured by a chain.

The **dust covers,** of steel, are fitted to prevent the ingress of dirt, etc., through the side openings, to the interior. They are attached to the crosshead pin and designed to slide in guide clips secured by screws to the compressor body. The access hole cover is curved to the contour of the body and secured by a screw.

The aperture in the screwed base is closed by fitting a steel disc.

The pump, when required for use, is secured by placing it in the saddle on the trail and turning it through 90 degrees until parallel to the trail, when it is locked by the locking bolt, the high-pressure cylinder being towards the cradle.

Action

The pump is fitted to the trail, with handle, pipe and adapter attached. The handle is moved to the rear causing the piston to move forward, and air is drawn in past the suction valve to the low-pressure chamber. The handle is now pushed to the front, moving the piston to the rear and displacing the air in the low-pressure chamber. The suction valve closes and the air is expelled past the delivery valve, connecting pipe and inlet valve into the high-pressure chamber. The second movement of the handle to the rear re-charges the low-pressure chamber, and expels the compressed air from the high-pressure chamber past the delivery valve into the recuperator.

Care and preservation

Before using the pump it is important to see that all parts are clean and free from dust or dirt, and that all working surfaces are properly lubricated; steel covers have now been fitted to prevent the ingress of dust, etc., to the interior.

A few drops of oil should be applied to the suction valve at intervals to ensure that the pistons and cylinders are properly lubricated.

The caps for both the delivery and suction ports must be removed before use and replaced immediately after, otherwise there is considerable risk of dirt getting into the pump and preventing the valves closing properly, with consequent failure of the pump. The slightest amount of dirt upon any valve or seating is sufficient to prevent correct functioning.

When working the pump, in order to obtain the best results, the handle should be moved through the full arc of movement at each stroke.

The pump should be worked a few strokes daily. The inlet strainer must be kept in working order, the cotton waste being renewed periodically.

All valves and springs should be inspected periodically to ascertain that they are clean; if dirty or gritty they should be removed, thoroughly cleaned, and lightly coated with oil before replacement. They must at all times be kept in correct adjustment.

When the pump is not being used it should be stored in the charging pump box. If the pump is not required for some considerable time, all bright steel parts should be thinly coated with mineral jelly.

To examine the piston, piston packings and chambers, remove the high-pressure and low-pressure covers, also dust-proof covers, remove the crosshead pin, when the forked lever can be detached and the piston withdrawn through the low-pressure chamber.

The H.P. and L.P. packing rings can be replaced when necessary by means of the Nos. 1 and 2 artillery tools, the No. 1 tool being used for the L.P. rings and the No. 2 for the H.P. rings. To replace the rings, place the new packing in the

tapered hole of tool bush, pass the piston through the tapered hole as far as necessary, place the clamp of the tool in position, insert the screw and T-handle and screw down slowly until the piston emerges at the opposite end, when the new ring will be found to be in position in its groove.

Replacement of packings

If found necessary the cup-shaped packing rings may be replaced by unscrewing the barrel cap and withdrawing the plunger. The end nut and washer can then be removed and packing rings replaced.

PUMP, HAND, SUCTION AND FORCE, SCREW ACTING, NO. 2

The *Mark I* pump (Fig. 72) is provided for the purpose of injecting a small quantity of liquid into the recuperator, whilst still retaining the air pressure. It consists of a steel barrel with cap, piston, piston rod and handle. The barrel is cylindrical, threaded externally at one end to receive the cap, the other end being reduced in diameter and threaded to screw into the filling hole L of the recuperator; a small delivery channel is bored through this end. The cap is bored centrally and threaded to accommodate similar threads on the piston rod; an oblique hole allows liquid, that may pass the piston, to escape and air to enter. The piston rod is of steel, screw-threaded for almost the entire length to work in the barrel cap. The outer end is formed square to take the handle and to the inner end is fitted a piston. The front face of the piston is provided with a cup-shaped leather held in position by supporting and securing rings, whilst the rear face is prepared with a hemispherical recess to accommodate the piston tumbler. The tumbler forms the means of attaching the piston to the rod and is secured to the head by means of the piston bush. The stem of the tumbler is threaded and screwed into the rod, being finally secured by a pin. The piston head is thus independent of any rotary movement of the rod.

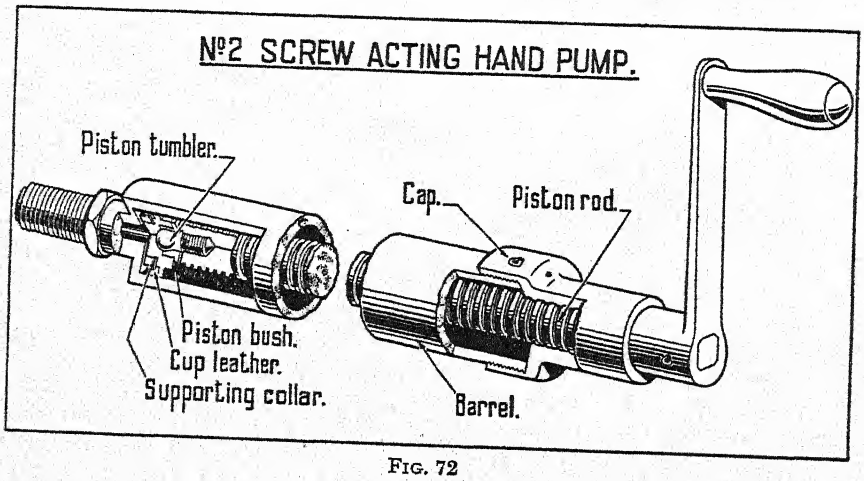


FIG. 72

The *Mark II* differs from the *Mark I* in being of solid drawn steel tubing and screw-threaded at each end to suit screwed caps, instead of being turned out of solid bar and screwed at the upper end only.

Action

The piston is first screwed fully into the barrel. The nozzle of the pump is then dipped into a quantity of buffer oil and whilst there, the piston is unscrewed as far as possible thus charging the pump with liquid by suction. The pump is then held with the nozzle slightly above the horizontal and the piston rod handle revolved a

turn or so to expel all air present in the barrel and in front of the piston. The pump barrel is now screwed into the filling hole L of the floating piston and secured in position by using a spanner on the flats formed on the nozzle. When fully home, the handle of the pump should be operated to force the liquid contents into the recuperator. This pump is used with the original type of floating piston.

Care and preservation

Replacement of packing

Remove the handle, unscrew the cap from the barrel and withdraw the piston. Unscrew the supporting ring from the piston head and replace the leather cup.

PUMP, LIQUID, NO. 2

The pump (Fig. 73) is for use in charging the recuperator with liquid. It consists of a base, suction valve and hose, delivery valve and hose, barrel, plunger with rod and handle.

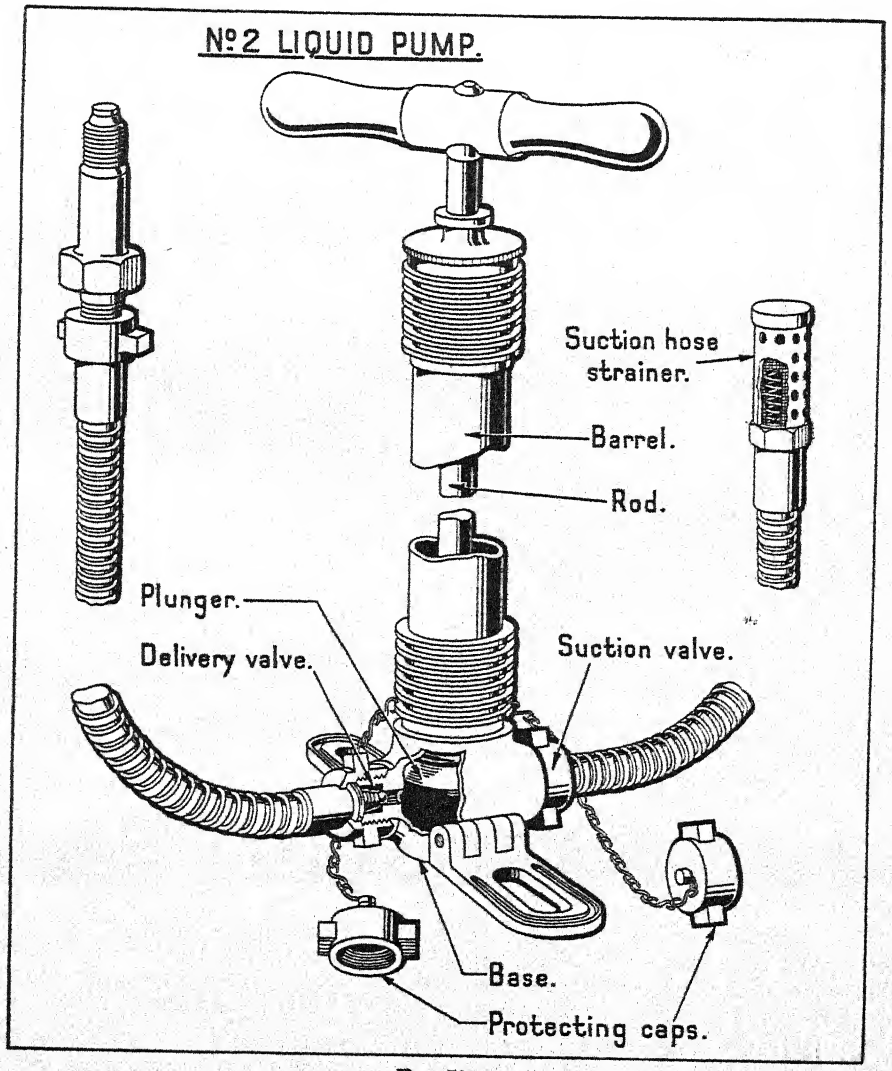


FIG 73

The **base** is a casting to which are hinged two bars for the feet of the operator when pumping. A central opening is formed to receive the lower end of the barrel; both barrel and base are pierced radially in two directions to form seatings for the suction and delivery valves, the exterior of the base being threaded for the unions of the suction and delivery hose.

The **valves** are steel balls resting in a suitable seating in the radial channel or plug and kept on the seating by a spring supported at the other end. The ball, under pressure of the spring, closes the communicating channel between pump and hose.

The **hoses** are of flexible metallic tubing, the suction hose being of $\frac{3}{4}$-inch bore, 60 inches long, and fitted with a strainer at its outer end.

The delivery hose is of $\frac{1}{2}$-inch bore, 72 inches long, and fitted at the outer end with a union for its attachment to the adapter. The inner ends of both hoses are fitted with unions for their attachment to the nozzles of the base. Protecting caps, secured by chains, fit on these nozzles when the hoses are detached.

The pump barrel is cylindrical and fits into a recess in the base, to which it is secured. The upper end is closed by a screwed-on cover, having a central opening for the plunger rod which works through it; protecting gills surround the exterior of the barrel.

The plunger rod has a handle on the outer end; it is fitted on the inner end with two cup-shaped leather washers, and is assembled with the necessary supporting and dividing washers.

Action

The suction and delivery hose having been assembled on the base, the former is placed in the vessel containing buffer oil and the latter connected to the filling hole L by means of the adapter. The withdrawal of the plunger from the barrel causes the suction valve to open, and allows liquid to be drawn from the vessel into the barrel under suction. The downward stroke of the plunger closes the suction valve and opens the delivery valve, forcing liquid through the delivery pipe into the recuperator as described on page 89.

Where the new pattern rod is fitted this pump is used with the No. 17 adapter in the N plug-hole, the No. 246 artillery tool taking up the pressure on the rod.

Care and preservation

The pump will be operated a few strokes daily to ensure that the packings are working properly.

RAMMER, Q.F. 25-PR.

The rammer, of ash, is 30 inches long and has circumferential grooves at one end to ensure an efficient grip when ramming. The other end is shaped to bear against the base of the shell and is provided with a copper ferrule secured by brass screws. The plain portion of the stave is protected by a copper sheath secured by soldering and copper tacks.

RESERVOIR, COMPRESSED AIR, 5½-INCHES DIAMETER

The reservoir (Fig. 74) consists principally of the body, preserving plug, valve union and valve key with gland.

The body, of steel, is cylindrical in shape with hemispherical ends; one end is formed into a short parallel neck, screw-threaded internally to receive a gunmetal valve socket containing a bronze valve spindle; the spindle is coned at the inner end to fit into its seating in the socket and is formed into a square at its outer end.

The preserving plug, of gunmetal, is fitted with a leather washer under the flange and is screw-threaded to screw into the valve socket when the reservoir is not in use.

The **valve union,** of bronze, is screw-threaded externally at its inner end to screw into the valve socket when the reservoir is in use and internally at its outer end to take the valve gland, while a projection on the side is screw-threaded to accommodate the No. 2 charging pipe. The union is bored longitudinally to take the valve key and transversely to allow passage for the air. A copper washer is interposed between the valve socket and a shoulder on the union.

The **valve key,** of steel, is contained inside the union and is thickened at the inner end and formed with a square recess to receive the head of the valve spindle, whilst the outer end passes through the gland and is formed with a square head to fit a removable steel handle. Greased hemp packing is inserted in the outer end of the valve socket and suitably compressed by means of the gland.

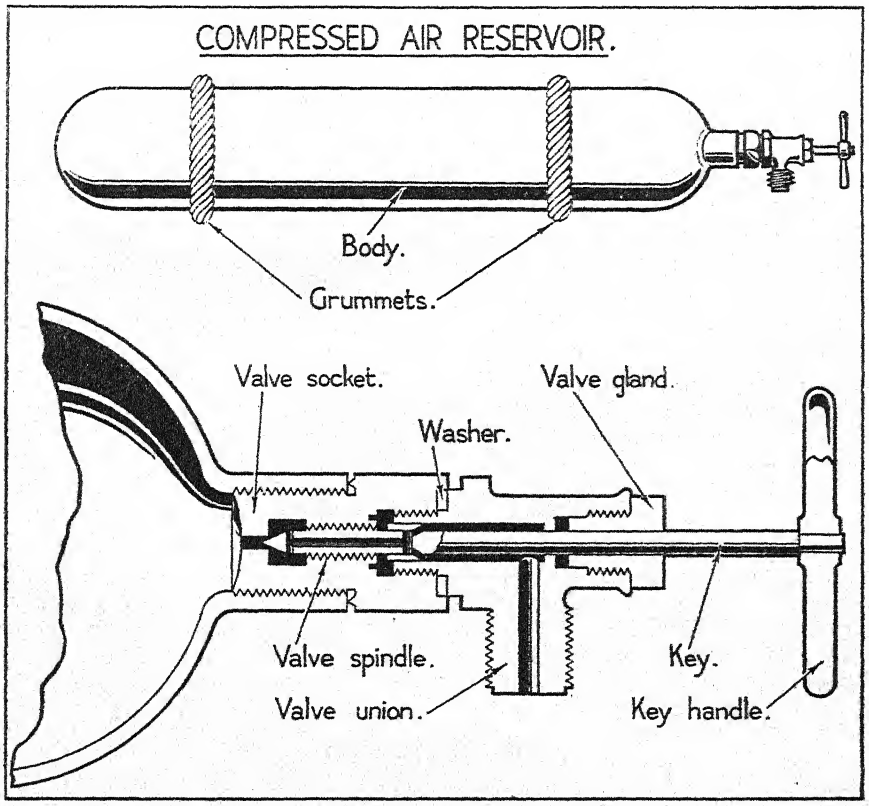


FIG. 74

The **gland,** of gunmetal, is screw-threaded externally to screw into the outer end of the union.

To protect the reservoir from jar, two grummets made up of 3-inch tarred rope are fitted over the body about 7 inches from each end.

When not in use the reservoir is closed by the preserving plug; when required for use the preserving plug is replaced by the valve union.

The overall length is 31·8 inches and the working pressure is 1,800-lb. per square inch.

Care and preservation

A history sheet (I.G.A., Form 269A) is prepared for each reservoir and is intended to record the history of the reservoir. The result of all tests will be recorded and also anything calling for special remark.

Reservoirs will be tested biennially by the R.E.M.E. to ascertain whether they are in serviceable condition.

Before issue to units the R.E.M.E. will paint the test pressure and date on the reservoir as follows: TESTED.....LB. ON..... At the expiration of two years from the date of the last test, as indicated by the particulars painted on the reservoir, the unit will be responsible for sending the reservoir to the R.E.M.E workshop for the biennial test.

The result of the test will be entered on A.F. G881B by the R.E.M.E., who will forward the completed form to the I.G.A.

Before reservoirs are returned to store, they will be emptied and the word EMPTY stencilled on them.

Filled reservoirs will be stencilled with the word FILLED and with the amount of pressure in them before issue to units by the R.E.M.E. Care must be taken in moving reservoirs, that they are not thrown down or roughly handled and that the rope grummets, where provided, are in position to protect them from jar. Reservoirs must not be allowed to rust under the grummets.

Air reservoirs will be used solely for containing compressed air and will be marked by painting along the reservoir, in letters of suitable size, the words COMPRESSED AIR ONLY.

Reservoirs must be handled with great care; the two protecting grummets on the body should always be in position; broken or damaged grummets should be replaced as soon as possible.

During hot weather, particularly at stations abroad, reservoirs should be protected from the sun by wadmiltilts or other suitable material.

ROLL, SPARE PARTS, 25-PR.

The *Mark I* roll is of service colour waterproof canvas, furnished on the inside with eight stitched pockets of various sizes designed to contain spare parts. When open the roll measures 24 inches in length and 20 inches in width. It is closed by folding half of the roll over the pockets containing the spare parts and is secured by a hemp line which is stitched to the outside of the roll. The roll, which is carried in the spare parts box, has "SPR. PTS. 25-PR." stencilled on the outside.

ROLL, TOOLS, 25-PR.

The *Mark I* roll is generally similar to the spare parts roll described above.

When open it measures 60 inches in length and 33 inches in width. It has five large and nine smaller pockets and is secured by two hemp lines.

The roll has "TOOLS 25-PR." stencilled on the outside and is carried in the tools box.

SLING, FIRING, 25-PR.

The *Mark I* sling consists of a web strap with buckle, link, loop and tip.

It is of 2-inch drab web, fitted at one end with a tongueless and running loop, and at the other end with a metal tip. A loop connecting with the firing mechanism is attached to the web portion of the sling by a sliding link.

The sling enables the gunlayer, by passing his arm through it, to retain his hold on the hand wheel whilst firing the gun.

STOP, RUNNING BACK, NO. 3

The stop is a steel angle bracket having a screw-threaded stud on the lower side of the short arm to enter a corresponding hole in the cradle, where it is retained by a set screw and lock nut.

It is used to prevent the gun slipping back when charging the recuperator.

TOOL, ARTILLERY, NO. 246

The tool, of steel, is a hollow steel bar bored and screw-threaded at one end to receive a T-handled force screw. The opposite end is bored and screw-threaded to enable the tool to be assembled on the cradle front cap. A slot is cut in one of the flats for inspection purposes.

SPANNERS AND SPECIAL IMPLEMENTS

Designation	Detail of use
Keys—	
No. 11	Steel; box pattern, for run-out control valve.
No. 12	Steel; box pattern, for snifting valve plug, filling-hole plug, air relief floating piston.
No. 14 Mark II	Steel; for air valve.
Spanners—	
No. 244	For sight clinometer.
No. 781	Double-ended pattern, for buffer stuffing box, adapter floating piston, buffer rear plug, buffer gland and floating piston gland.
No. 782	Double-ended pattern, for recuperator gland and stuffing box.
Nos. 2, 3 and 5 horizontal air pump—	
Large	For No. 5 horizontal air pump.
Small	
Tools, artillery—	
No. 1	Steel frame with bush and handle for inserting large piston packing Nos. 2, 3 and 5 horizontal air pump.
No. 2	Steel frame with bush and handle for inserting small piston packing Nos. 2, 3 and 5 horizontal air pump.
No. 85	Bronze; chamber tupping tool for inserting loose barrel.
No. 86	Bronze; muzzle tupping tool for removing loose barrel.
No. 201	For withdrawing gland rings.
No. 215	For testing aeration of liquid in recuperator.
No. 216	Removing and inserting piston.
No. 217 Mark II	For assembling recuperator U-rubber.
No. 218	For supporting floating piston during use of screw pump when front cap is in position.
No. 219	For supporting floating piston during use of screw pump when front cap is removed.
No. 224	Steel, for assembling U-packing on buffer rod.
No. 216	Steel, for withdrawing floating piston.
No. 233	Steel, for assembling floating piston, U-section packings.
No. 246	Steel, for forcing back recuperator floating piston.
No. 247	Steel, for setting cut-off gear.
Wrenches—	
Adjusting No. 7 to 7C dial sight	For the No. 7 to 7C dial sight and carrier.
Breech mechanism—	
No. 247	For firing-hole bush.
Sealing collar	For tightening and removing sealing collar.

CHAPTER V

AMMUNITION

STATEMENT OF AMMUNITION Q.F. 25-PR.

CARTRIDGES

Nature and size of propellant	Weight of portions of charge No. 1	No. 2	No. 3	Total weight	Mark of cartridge	Mark of cartridge case	Percussion primer	Igniter	Remarks
	oz. dr.	oz. dr.	lb. oz. dr.	lb. oz. dr.					
Cordite, M.D.8 and 2¼ or R.D.B.8 and 2¼	6 1	8 0	0 12 12	1 10 13	I	II or IIS	No. 1, Mk. II or IIM		Obsolescent.
Cordite, W.057 or W.M.061 and W.016 or W.M.017	—	7 12	13 3	1 11 4	I to V	,,	,,		
Cordite, N.Q./R.014–048 N.Q.050	6 5 7 2	— —	— —						
Cordite, N.Q.045 and N.Q.T.05–03	— —	8 8 8 10	0 14 10 0 14 12	1 14 4 1 14 8	I I	,, ,,	— No. 11		
Cordite, N.H.025 or 023	7 2 7 11	— 9 5	— 1 0 4	2 1 4	I	,,	,,		
Cordite, N.H.025 or 023	7 11	9 5	1 0 4	2 1 4	II	,,	No. 1, Mk. II	C.D. No. 30	
Cordite, N.H.012 and F.N.H.023	7 7 —	— 9 12	— 1 0 9	2 1 12	I	,,	,,	,,	Obsolescent.
Cordite, N.H.012 and F.N.H.023	7 7 —	— 9 12	— 1 0 9	2 1 12	II	,,	No. 11	,,	,,
Cordite, N.H.012 and F.N.H.023	7 7 —	— 9 12	— 1 0 9	2 1 12	III	,,	No. 1, Mk, II	,,	
Cordite, N.H.012 and F.N.H.023	7 7 —	— 9 12	— 1 0 9	2 1 12	IV	,,	No. 11	,,	
Cordite, W.T.206–100 or W.M.T.211–100	—	—	—	2 8 0	I foil	,,	No. 1, Mk. II or IIM		Supercharge.
Cordite, S.C.T.198–100	—	—	—	2 9 14	,,	,,	,,		,,
Cordite, N.Q./S.134–040	—	—	—	2 13 8	,,	,,	,,		,,
M.D.4¼	—	—	—	2 0 0	I	,,	,,		For use with paper shot only.
Cordite, N.Q./S.144–040	—	—	—	2 13 8	I foil	,,	No. 11		Obsolescent.
Cordite, N.Q./S.134–040	—	—	—	0 5 8	—	—	—		Super charge increment for use with 20-lb. shell.
W.M.061	—	—	—	0 4 8	—	—	—		Ditto.
N.Q./R.014–048	—	—	—	0 4 0	—	—	—		Intermediate charge increment for use with charge 1 or 2.
Powder, blank, L.G. G.12 or R.F.G.2	—	—	—	1 0 0	I	,,	No. 1, Mk. II or IIM		Blank charge.

PROJECTILES

Nature	Mark	Number of			Dimensions			Weight							Design number of driving band	Remarks
		Fuze	Tracer	Plug	Length (excluding fuze, plug and external tracer socket)	Diameter		Shot or empty shell	Filling	Burster	Fuze	Tracer	Plug	Total		
						Body	Driving band									
					inches	inches	inches	lb. oz. dr.	lb. oz. dr.	lb. oz. dr.	lb. oz. dr.	lb. oz. dr.	lb. oz. dr.	lb. oz. dr.	DD(L)	
High explosive shell	ID	117, 117C, 119 and 222			13·84	3·44	3·56	20 10 13	1 13 3		2 8 0			*25 0 0	6487/2	
B.E. streamline smoke shell	ID	221			13·03	,,	,,	14 9 4	5 0 4	0 1 8	2 2 0			21 13 0	6487A/2	Obsolescent
,,	IID	221			13·03	,,	,,	14 8 12	5 0 4	0 1 8	2 2 0			21 12 8	,,	,,
,,	IIID	221			13·03	,,	,,	14 8 8	5 0 4	0 1 8	2 2 0			21 12 4	,,	,,
,,	IVD	221			13·03	,,	,,	14 10 10	5 0 4	0 1 8	2 2 0			21 14 6	6487/7	,,
,,	VD	221			11·71	,,		14 7 14	5 0 4	0 1 8	2 2 0			21 11 10	,,	,,
,,	VID	221			11·71	,,	,,	14 7 10	5 0 4	0 1 8	2 2 0			21 11 6	,,	,,
B.E. smoke shell	VIIB	221			11·71	,,	,,	14 8 5	5 0 4	0 1 8	2 2 0			21 13 12	,,	
,,	IA	220			14·9	,,	,,	16 2 8	6 9 8	0 1 8	2 3 12			25 1 4	6487/2	
Armour piercing shot	IT		2 Mk. VIS		9·33	,,	,,	19 13 4				0 2 12		20 0 0	6487/3	Obsolescent
,,	IIT		2 Mk. VIS		9·43	,,	,,	19 13 4				0 2 12		20 0 0	,,	,,
,,	IIIT		Tracer Composition		9·31	,,	,,	19 15 13				0 0 3		20 0 0	,,	,,
,,	VIT		,,		9·28	,,	,,	19 15 7				0 0 3		20 0 0	,,	,,
,,	VIIIT		,,		9·28	,,	,,	19 15 7				0 0 3		20 0 0	,,	,,
Armour piercing shot capped	VIIT		,,		9·18	,,	,,	19 15 7				0 0 3		20 0 0	,,	
Practice projectile	ID			2 inch No. 1, Mk. III	12·87	,,	,,	19 1 12	†4 4				0 10 0	20 0 0	6487/2	
,,	IIDT			2 inch No. 1, Mk. III	12·87	,,	,,	19 2 12				0 3 4	0 10 0	20 0 0	,,	
Practice shot	IT		2 Mk. VII		9·43	,,	,,	19 13 4				0 2 12		20 0 0	6487/3	Obsolescent
,,	IIT		2 Mk. VII		10·13	,,	,,	19 13 4				0 2 12		20 0 0	,,	
,,	IIIT		Tracer Composition		9·43	,,	,,	19 15 13				0 0 3		20 0 0	,,	
,,	VT		,,		,,	,,	,,	19 15 13				0 0 3		20 0 0	,,	
,,	VIIIT		,,		,,	,,	,,	19 15 13				0 0 3		20 0 0		
Paper shot	I				17·3	,,	,,							7 0 0		
,,	II				51·9	3·4	3·55							40 0 0		

Total weight varies slightly according to the fuze used. † Weighting.

GENERAL

The ammunition used with this equipment is of the separate Q.F. type, i.e. the cartridge case is not attached to the projectile, in consequence of which they are loaded separately into the gun, thus giving facilities for varying the charge.

The term cartridge is applied to the brass case, propellant charge and percussion primer.

The propellant charges are of cordite and made up in three portions varying in weight and each portion is placed in either a red, white or blue bag in order to distinguish one from the other.

Fuzes, when issued separately, are supplied in hermetically sealed cylinders, which should not be opened until actually required for use.

Time and percussion fuzes used with smoke shell, when in the projectile are provided with a cover, soldered on, to protect the fuze from deterioration due to damp.

Cartridges are issued in boxes containing eight; shell are issued in boxes containing four, which are either plugged or fuzed.

In addition, a super-charge with a tinfoil or leadfoil sheet wrapping is supplied.

PRIMERS

PRIMER, PERCUSSION, Q.F. CARTRIDGE, NO. 1

The *Mark II* primer (Fig. 75) consists of a body, percussion cap, anvil plug, copper ball, screw plug and brass closing disc.

The body is of metal provided with a flange, in front of which it is screw-threaded externally to screw into the base of the cartridge case, and two slots are cut in the flange for the No. 34 key. The interior is bored, cupped and threaded to take the percussion arrangement.

The cap is of copper, and contains detonating composition covered by a tinfoil disc; it is placed in a recess in the body, and over it an anvil plug is screwed, having a coned seating, into which is placed a soft copper ball. Two fire holes are bored through the anvil plug to allow the flash from the cap to pass into the cone seating.

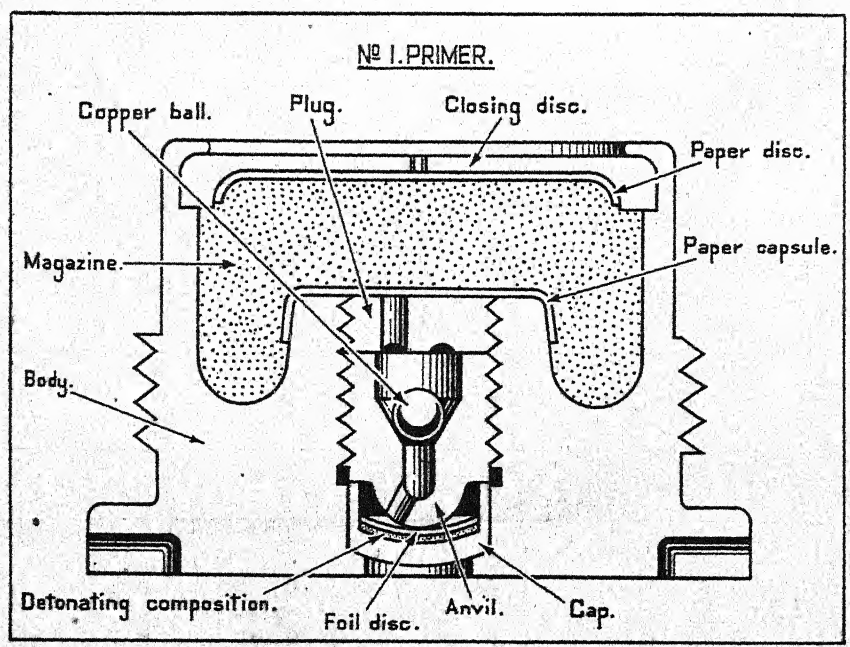


FIG. 75

The screw plug screws in on the anvil plug and retains the copper ball in position ; it is perforated by two fire channels and is covered by a paper capsule, to prevent the powder working into the ball seating. A fillet of cement is placed between the cap and body to prevent the ingress of damp.

The magazine of the primer contains R.F.G.2 or G.12 gunpowder covered by a brass disc ; this disc has six radial slits and a hole in the centre to weaken it, and has a paper disc secured to its under side with cement. The brass closing disc is secured in position by the metal of the primer being burred over it, and it is coated with cement.

The primer is marked as shown on page 235.

The primer is issued assembled in the cartridge ; in addition, spare primers are issued in boxes containing four, to replace misfired primers.

The letter M after the Mark indicates that the primer has been repaired and refilled.

Action

When the pin of the firing mechanism is driven by its spring on to the cap, the composition is ignited on the anvil ; the flame passes through the fire channels in anvil and plug, to ignite the gunpowder in the magazine. The magazine explodes, opens out the closing disc and ignites the propellant charge. The explosion of charge and magazine forces the copper ball into the coned seating of the anvil plug, closing the fire channels and preventing the escape of gas at that point. The wall of the primer is pressed outwards to grip the cartridge case tightly, and prevent gas escape between the primer and case.

PRIMER, PERCUSSION, Q.F. CARTRIDGE, NO. 11

The *Mark I* primer (Fig. 76) differs from the *Mark II* No. 1 Q.F. percussion primer principally in having a magazine screwed into the body. It is of brass, rounded at the front end and perforated with eight holes, a white-metal dome being inserted at the front end. A paper envelope is fitted internally and the magazine is filled with six drams of G.12 gunpowder.

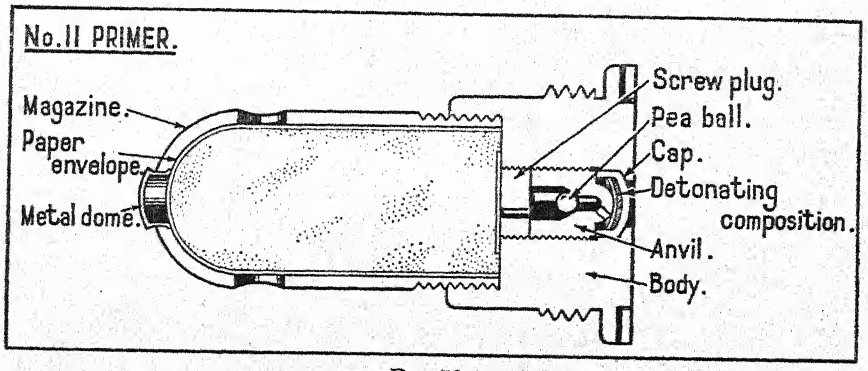


FIG. 76

The Mark IM is the Mark I repaired and refilled.

The Mark IMR is the Mark IM repaired, the anvil and plug being of increased diameter.

The *Mark II* primer is generally similar to the *Mark I* but is provided with a conical plug of soft copper instead of a ball and has two flash holes coincident with the commencement of the grooves formed in the screwed plug.

The *Mark III* primer has a screwed plug of modified design, but is otherwise identical with the Mark II.

PROPELLANT CHARGES

NORMAL CHARGES

The normal charge is made up of three portions, a core and two bundles, each of which is contained in a cambric bag. The weight of the charge necessarily varies according to the nature and size of the propellant used, and the dimensions of the bags have, consequently, to be varied accordingly. In order to differentiate between the sizes of bags, used with the various propellants, each complete set of three bags is allotted a distinguishing letter. For example—the empty C and D bags differ principally from the A bag in the dimensions of the red bag that forms part of each complete set.

The first portion, or core, of the charge is contained in a red bag and is charge one. The second portion is in a white bag and, when combined with the first portion, forms charge two. The third portion is in a blue bag, and the whole charge, first, second and third portions together, form charge three.

Where tinfoil is mentioned leadfoil may be employed as a substitute.

CARTRIDGE, Q.F. 25-PR., FILLED 1 LB. 10 OZ. 13 DR.

The charge (Fig. 77) is of M.D. or R.D.B. cordite, sizes 8 and 2¼, and is enclosed in an A or B bag.

The size and weight of the propellant in each portion of the charge is as follows :—

No. 1 portion (core), size 2¼	0 lb. 6 oz. 1 dr.
No. 2 portion, size 8	0 lb. 8 oz. 0 dr.
No. 3 portion, size 8	0 lb. 12 oz. 12 dr.

The No. 1 portion is made up of size 2¼ cordite in the form of a cylindrical core of 2·5-inch sticks surrounded by a ring of 3·2-inch sticks, each bundle being secured with sewing silk. The portion is secured in such a manner as to leave a recess to fit over the percussion primer and is contained in a red cambric bag which is finally secured to the bottom of the case with shellac.

Nos. 2 and 3 portions each consist of a loose bundle of 5·2-inch cordite sticks, No. 2 portion being contained in a white cambric bag, whereas No. 3 portion is contained in a blue cambric bag provided with a lifting becket.

Two leatherboard cups retain the charges in position, one being inserted into the case until it bears against the charge whilst the second cup is pressed against the first until flush with the mouth of the case. The cups are provided with tape loops, by which means they are removed from the case. The primer used is the No. 1.

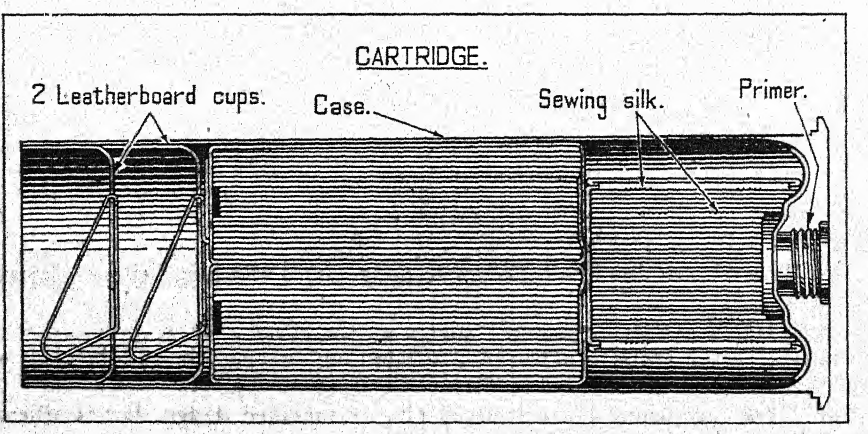


FIG. 77

CARTRIDGE, Q.F. 25-PR., FILLED 1 LB. 11 OZ. 4 DR.

The *Mark I* charge is of cordite W.057 or W.M.061, and W.016 or W.M.017, and is generally similar in make-up to the 1 lb. 10 oz. 13 dr. charge previously described. The size and weight of cordite in each portion is as follows :—

No. 1 portion (core), W.016 or W.M.017	0 lb. 6 oz. 5 dr.
No. 2 portion, W.057 or W.M.061 ..	0 lb. 7 oz. 12 dr.
No. 3 portion, W.057 or W.M.061 ..	0 lb. 13 oz. 3 dr.

The primer used is the No. 1.

The *Mark II* charge differs from the *Mark I*, and the *Mark III* from the *Mark II* in the length of the cordite sticks employed. The Mark II is contained in a C bag and the Mark III in a D.

CARTRIDGE, Q.F. 25-PR., FILLED 2 LB. 1 OZ. 12 DR.

N.H.012 AND F.N.H.023

The *Mark I* charge consists of 2 lb. 1 oz. 12 dr. of N.H.012 and F.N.H.023 contained in an F cambric bag, and is made up in three portions.

The first portion is the first charge and consists of 7 oz. 7 dr. of N.H.012 enclosed in a red cambric bag. The second and third portions consist of 9 oz. 12 dr. and 1 lb. 0 oz. 9 dr. of F.N.H.023 respectively, the second portion being enclosed in a white and the third portion in a blue cambric bag. One-sixth oz. of tinfoil or lead foil, loosely crumpled, is inserted in the blue bag after filling. A C.D.30 igniter is incorporated in the charge. The cartridges are packed eight in a C.206 box. The first and second portions form charge two, and the first, second and third portions form charge three. This cartridge is now obsolescent.

The *Mark II* charge differs from the *Mark I* in being fitted with a No. 11 primer, and the omission of the C.D. No. 30 igniter. This cartridge is now obsolescent.

The *Mark III* charge differs from the *Mark I* only in the first portion of the cartridge having two strips of kraft paper secured lengthwise, the ends being secured to the second and third charges to ensure a compact bundle. The first portion is secured to the bottom of the cartridge case with shellac.

The *Mark IV* charge is similar to the *Mark II* differing only in the first portion of the cartridge having two strips of kraft paper secured lengthwise, the ends being secured to the second and third charges to ensure a compact bundle. The first portion is secured to the bottom of the cartridge case with shellac.

CARTRIDGE, Q.F. 25-PR., FILLED 1 LB. 14 OZ. 8 DR.

CORDITE N.Q.045 AND N.Q.T.05–03

The N.Q.045 and N.Q.T.05–03 charge consists of 1 lb. 14 oz. 8 dr. cordite in an E bag and is made up in three portions, charges one, two and three, as follows :—

	lb.	oz.	dr.	
1st portion	0	7	2	N.Q.T.05–03
2nd portion	0	8	10	N.Q.045
3rd portion	0	14	12	N.Q.045
	1	14	8	

The first portion of the charge is made up with cordite N.Q.T.05–03 and consists of a cylindrical core of 1-inch sticks surrounded by a ring of 3·2-inch sticks, each bundle being tied with sewing silk. This portion is recessed at the base to fit over the primer and is enclosed in a red cambric bag secured to the bottom of the case with shellac.

The second and third portions each consist of a bundle of sticks of N.Q.045 cordite, each stick being 6·2 inches in length. In other respects the cartridge is generally similar in make up to the foregoing. The primer used is the No. 11.

PROPELLANT CHARGES

NORMAL CHARGES

The normal charge is made up of three portions, a core and two bundles, each of which is contained in a cambric bag. The weight of the charge necessarily varies according to the nature and size of the propellant used, and the dimensions of the bags have, consequently, to be varied accordingly. In order to differentiate between the sizes of bags, used with the various propellants, each complete set of three bags is allotted a distinguishing letter. For example—the empty C and D bags differ principally from the A bag in the dimensions of the red bag that forms part of each complete set.

The first portion, or core, of the charge is contained in a red bag and is charge one. The second portion is in a white bag and, when combined with the first portion, forms charge two. The third portion is in a blue bag, and the whole charge, first, second and third portions together, form charge three.

Where tinfoil is mentioned leadfoil may be employed as a substitute.

CARTRIDGE, Q.F. 25-PR., FILLED 1 LB. 10 OZ. 13 DR.

The charge (Fig. 77) is of M.D. or R.D.B. cordite, sizes 8 and 2¼, and is enclosed in an A or B bag.

The size and weight of the propellant in each portion of the charge is as follows :—

No. 1 portion (core), size 2¼	0 lb. 6 oz. 1 dr.
No. 2 portion, size 8	0 lb. 8 oz. 0 dr.
No. 3 portion, size 8	0 lb. 12 oz. 12 dr.

The No. 1 portion is made up of size 2¼ cordite in the form of a cylindrical core of 2·5-inch sticks surrounded by a ring of 3·2-inch sticks, each bundle being secured with sewing silk. The portion is secured in such a manner as to leave a recess to fit over the percussion primer and is contained in a red cambric bag which is finally secured to the bottom of the case with shellac.

Nos. 2 and 3 portions each consist of a loose bundle of 5·2-inch cordite sticks, No. 2 portion being contained in a white cambric bag, whereas No. 3 portion is contained in a blue cambric bag provided with a lifting becket.

Two leatherboard cups retain the charges in position, one being inserted into the case until it bears against the charge whilst the second cup is pressed against the first until flush with the mouth of the case. The cups are provided with tape loops, by which means they are removed from the case. The primer used is the No. 1.

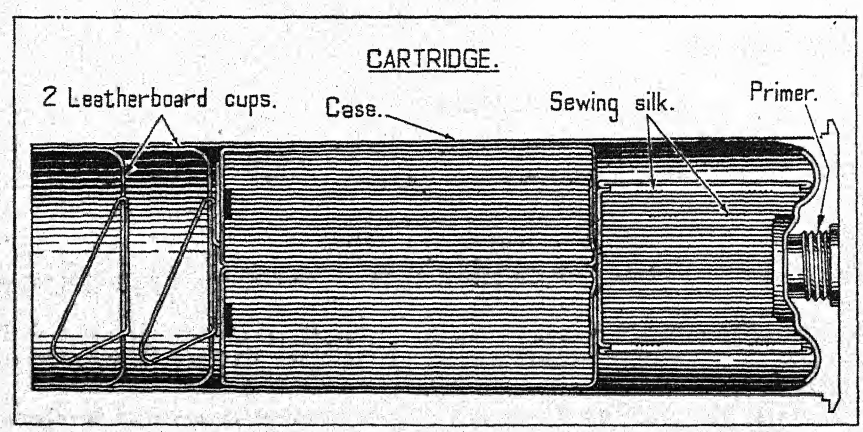


FIG. 77

CARTRIDGE, Q.F. 25-PR., FILLED 1 LB. 11 OZ. 4 DR.

The *Mark I* charge is of cordite W.057 or W.M.061, and W.016 or W.M.017, and is generally similar in make-up to the 1 lb. 10 oz. 13 dr. charge previously described. The size and weight of cordite in each portion is as follows :—

No. 1 portion (core), W.016 or W.M.017	0 lb. 6 oz. 5 dr.
No. 2 portion, W.057 or W.M.061 ..	0 lb. 7 oz. 12 dr.
No. 3 portion, W.057 or W.M.061 ..	0 lb. 13 oz. 3 dr.

The primer used is the No. 1.

The *Mark II* charge differs from the *Mark I*, and the *Mark III* from the *Mark II* in the length of the cordite sticks employed. The Mark II is contained in a C bag and the Mark III in a D.

CARTRIDGE, Q.F. 25-PR., FILLED 2 LB. 1 OZ. 12 DR.

N.H.012 AND F.N.H.023

The *Mark I* charge consists of 2 lb. 1 oz. 12 dr. of N.H.012 and F.N.H.023 contained in an F cambric bag, and is made up in three portions.

The first portion is the first charge and consists of 7 oz. 7 dr. of N.H.012 enclosed in a red cambric bag. The second and third portions consist of 9 oz. 12 dr. and 1 lb. 0 oz. 9 dr. of F.N.H.023 respectively, the second portion being enclosed in a white and the third portion in a blue cambric bag. One-sixth oz. of tinfoil or lead foil, loosely crumpled, is inserted in the blue bag after filling. A C.D.30 igniter is incorporated in the charge. The cartridges are packed eight in a C.206 box. The first and second portions form charge two, and the first, second and third portions form charge three. This cartridge is now obsolescent.

The *Mark II* charge differs from the *Mark I* in being fitted with a No. 11 primer, and the omission of the C.D. No. 30 igniter. This cartridge is now obsolescent.

The *Mark III* charge differs from the *Mark I* only in the first portion of the cartridge having two strips of kraft paper secured lengthwise, the ends being secured to the second and third charges to ensure a compact bundle. The first portion is secured to the bottom of the cartridge case with shellac.

The *Mark IV* charge is similar to the *Mark II* differing only in the first portion of the cartridge having two strips of kraft paper secured lengthwise, the ends being secured to the second and third charges to ensure a compact bundle. The first portion is secured to the bottom of the cartridge case with shellac.

CARTRIDGE, Q.F. 25-PR., FILLED 1 LB. 14 OZ. 8 DR.

CORDITE N.Q.045 AND N.Q.T.05–03

The N.Q.045 and N.Q.T.05–03 charge consists of 1 lb. 14 oz. 8 dr. cordite in an E bag and is made up in three portions, charges one, two and three, as follows :—

	lb.	oz.	dr.	
1st portion	0	7	2	N.Q.T.05–03
2nd portion	0	8	10	N.Q.045
3rd portion	0	14	12	N.Q.045
	1	14	8	

The first portion of the charge is made up with cordite N.Q.T.05–03 and consists of a cylindrical core of 1-inch sticks surrounded by a ring of 3·2-inch sticks, each bundle being tied with sewing silk. This portion is recessed at the base to fit over the primer and is enclosed in a red cambric bag secured to the bottom of the case with shellac.

The second and third portions each consist of a bundle of sticks of N.Q.045 cordite, each stick being 6·2 inches in length. In other respects the cartridge is generally similar in make up to the foregoing. The primer used is the No. 11.

CARTRIDGE, Q.F. 25-PR., FILLED 2 LB. 1 OZ. 4 DR. CORDITE N.H.025 OR 023

The *Mark I* charge is of N.H. 025 or 023, contained in an F bag. The weight of propellant in each portion is as follows :—

No. 1 portion (core)	0 lb. 7 oz. 11 dr.
No. 2 portion	0 lb. 9 oz. 5 dr.
No. 3 portion	1 lb. 0 oz. 4 dr.

The bag containing the first portion is sewn together at the ends to form a ring, but in other respects the cartridge is made up in a similar manner to those previously described. The primer used is the No. 11.

The *Mark II* cartridge is fitted with a No. 1 primer and an igniter consisting of 126 gr. of G.12 gunpowder in a bag of red shalloon. Otherwise it is identical with the Mark I.

CARTRIDGE Q.F. 25-PR., FILLED 2 LB. 8 OZ. 0 DR. CORDITE W.T.206–100 OR W.M.T.211–100

This super charge (Fig. 78) consists of 2 lb. 8 oz. of W.T.206–100 or W.M.T.211–100 cordite with a $\frac{1}{8}$ oz. tinfoil sheet wrapped around the charge.

The charge is made up in the form of a cylindrical core of 8-inch sticks weighing 12 oz., surrounded by a ring of 9·25-inch sticks weighing 1 lb. 12 oz., each bundle being secured with sewing silk. The tinfoil sheet is wrapped round the charge towards the front end and secured under ties of No. 1 sewing silk.

The charge has a recess formed at the base to fit over the percussion primer, and is finally secured to the bottom of the case with shellac.

The charge is contained in a brass case which is closed at the mouth with a leatherboard cup and is retained in position by shellac.

A certain number of cartridges, similar in all other respects to the above but containing 2 lb. 8 oz. 8 dr. of cordite, have been manufactured and issued to the service.

CARTRIDGE, Q.F. 25-PR., FILLED 2 LB. 9 OZ. 14 DR. CORDITE S.C.T.198–100

The 2 lb. 9 oz. 14 dr. charge is of cordite S.C.T.198–100 and the primer used is the No. 1. The charge is made up in a similar manner to the other super charge previously described.

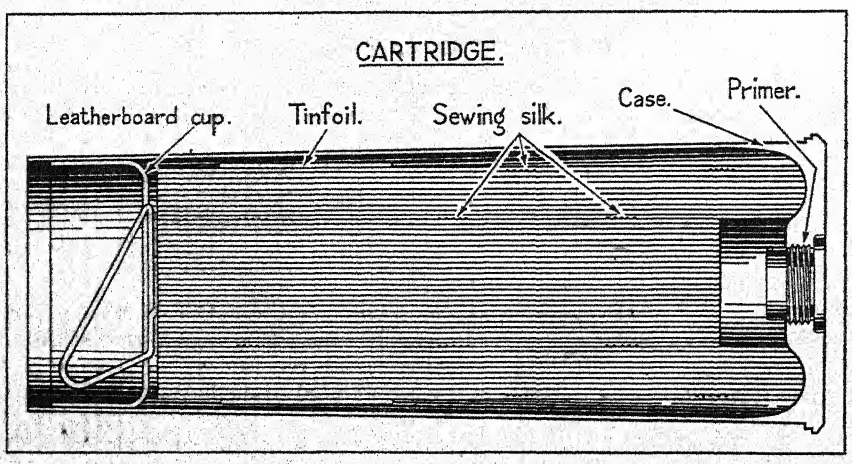


FIG. 78

CARTRIDGE, Q.F. 25-PR., FILLED 1 LB. 14 OZ. 4 DR. CORDITE N.Q./R.014-048 AND N.Q.050 MARK I FOIL

The *Mark I* charge, consisting of 1 lb. 14 oz. 4 dr. of cordite N.Q./R.014–048 and N.Q.050, is contained in an H cambric bag and is made up in three portions.

The first portion is the first charge and consists of 7 oz. 2 dr. of cordite N.Q./R.014–048 enclosed in a red cambric bag. The second and third portions consist of 8 oz. 8 dr. and 14 oz. 10 dr. cordite N.Q.050 respectively. The second portion being contained in a white and the third portion in a blue bag.

The first portion is made up of 8-inch length sticks, while the second and third portions are of 6½-inch length sticks.

Lead, or tinfoil, loosely crumpled, is inserted in the blue bag after filling.

A strip of Kraft paper is secured lengthwise around the cartridge to ensure a compact bundle, the lower ends, together with the first portion of the cartridge, being secured to the bottom of the cartridge case with shellac.

The first and second portion form charge two, while the first, second and third portions form charge three, a No. 11 primer being fitted.

CARTRIDGE, Q.F. 25-PR., FILLED 2 LB. 13 OZ. 8 DR. CORDITE N.Q./S.134-040, FOIL

The *Mark I* super charge is made up from 28-inch length cordite and consists of a cylindrical bundle of 9·3-inch length sticks, secured with sewing silk ties, arranged at the base to fit around the No. 11 primer.

Tin, or lead foil, loose crumpled, is placed on top of the charge.

The charge is contained in a brass case which is closed at the mouth with a leatherboard cup and is retained in position by shellac.

CARTRIDGE, Q.F. 25-PR., FILLED 2 LB. 13 OZ. 8 DR. CORDITE N.Q./S.144-040, MARK I FOIL

The *Mark I* charge is made up from 28-inch length cordite and consists of a cylindrical core of 7-inch length sticks surrounded with a ring of 9·3-inch length sticks, each bundle secured with sewing silk ties, and arranged at the base to fit around the No. 11 primer.

Tinfoil, or leadfoil sheet, is wrapped round the forward end of the charge and secured under sewing silk ties.

The cartridges are issued packed 8 in a C.206 box. It is obsolescent.

CHARGES FOR USE WITH PAPER SHOT
CARTRIDGE, Q.F., S.R., 25-PR., FILLED, 2 LB.

The *Mark I* cartridge consists of a charge of 2 lb. of M.D. cordite size 4¼, which is contained in a cartridge case, where it is held in position by a leatherboard cup.

The charge, which is in the form of a cylindrical core surrounded by a ring, is made up of cordite sticks each 7½ inches in length, and is so assembled as to form a recess for the boss of the primer. The core is secured with ties of sewing silk and the ring with ties of shalloon braid.

The cartridge is for use with paper shot, which are issued to provide training in flash spotting and sound ranging, and for proofing the gun and recoil system.

A 1 lb. 12 oz. W.040 or W.M.042 cartridge is also approved for use with paper shot.

CASE

The *Mark II* case is of solid-drawn brass slightly tapered from the base to within 1·1 inches of the mouth, where it is cylindrical. The base is recessed, bored centrally and screw-threaded to receive the percussion primer; it projects circumferentially to form a rim by means of which the extractor of the breech mechanism automatically ejects the case when the breech is opened after firing.

The case fulfils a dual purpose, *viz.* a container for the propellant charge and by expansion on firing ensures breech obturation.

The Mark IIS case is a Mark II case that has been repaired by rebushing the primer hole.

PROJECTILES

The projectiles used with this equipment are :—

High explosive
Smoke, B.E.
Armour-piercing shot.

The H.E. and smoke shell are manufactured from forged steel and have the 2-inch fuze-hole gauge.

The A.P. shot is of cast or forged steel. The driving bands are of copper to the design shown in (Fig. 79), except for slight differences.

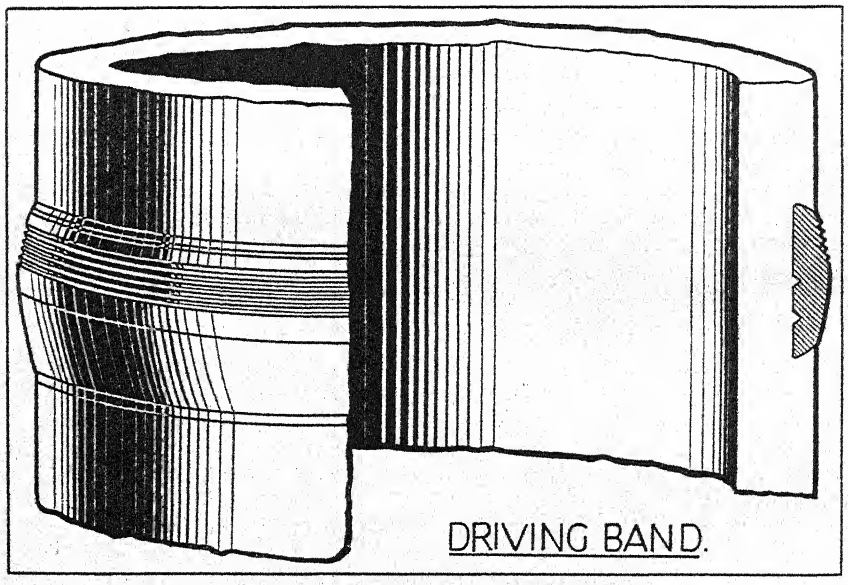


FIG. 79

The H.E. and smoke projectiles are streamline, approximately of 10 c.r.h. A certain number of obsolescent smoke projectiles of 4 c.r.h. may still be met with in the service. The A.P. shot is 1·4 c.r.h.

Projectiles are painted, primarily in order to preserve the bodies from rust. Advantage is taken of this necessity to indicate by the colour employed the nature of the filling. *See* Chapter VI.

HIGH EXPLOSIVE SHELL

The *Mark I D* high explosive shell (Fig. 80) has a radius of head of approximately 10 calibres, the base below the driving band being gradually reduced in diameter to form a streamline. Near the base is an undercut groove with waved or knurled ribs into which is pressed a copper driving band to design D.D.(L)6487/2.

The body has a cavity with parallel walls for the major portion of its length, the head being screw-threaded internally to the 2-inch fuze-hole gauge. A hardened steel base plate is riveted or screwed into a recess formed in the base.

The shell contains a bursting charge of T.N.T., which is poured in, a cavity being left in the centre of the charge and lined with a paper tube to accommodate a Mark III 2¼-oz. smoke box, which consists of a steel cylinder with a tinned-plate lid, the latter being soldered on after filling. The cylinder contains three pellets of red phosphorus wrapped in fine white paper, together with two paper discs. A waxed boxcloth disc is placed below the smoke box and waxed glazeboard discs, as required, are placed between the smoke box and C.E. exploder.

Inserted in the cavity above the smoke box is a B exploder of C.E. marked END UP.

A waxed felt washer, inserted whilst hot, is placed above the T.N.T. bursting charge, the lip of the paper tube being turned over the washer; a waxed millboard is then inserted above the paper tube.

Two cloth discs are finally inserted between the top of the C.E. exploder and the fuze or plug (Nos. 13 or 13 converted plugs only).

The fuzes normally used with this shell are the Nos. 117, 117C, 119 or 222. The No. 222 time and percussion fuze is used for air burst ranging.

The No. 13 or No. 13 converted, 2-inch fuze-hole plugs are used, or alternatively the No. 3 or No. 3 converted. The No. 3 plugs are obsolescent.

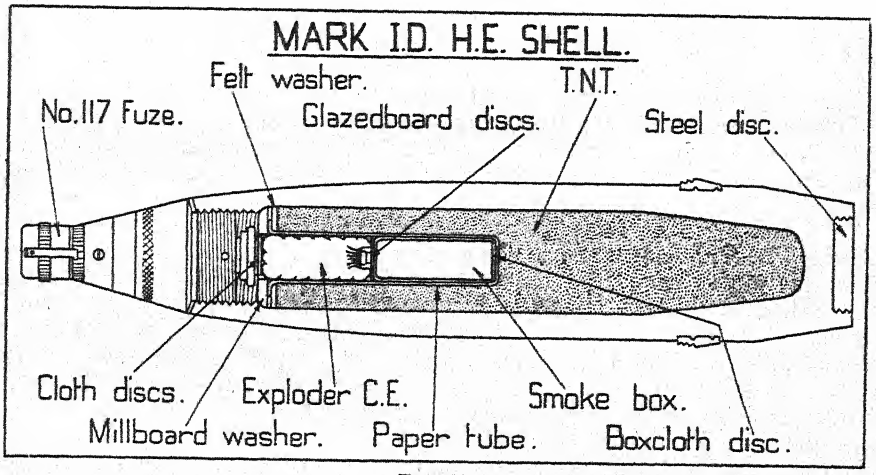


FIG. 80

It should be noted that the stem of the No. 3 or No. 3 converted plugs fills the cavity normally occupied by the B exploder, consequently, in this case, the exploder is inserted after the plug has been removed immediately before fuzing.

A leather washer is inserted between the flange of the plug and the top of the shell; it is essential that this washer be removed with the plug before inserting the fuze.

The threads of the fuze or plug should be treated with approved luting before inserting into the shell.

The nominal weight of the shell, filled and fuzed, is 25 lb.

Other shell, filled cold-pressed 60/40 amatol with a topping of T.N.T., have a 1½-oz. or 1¼-oz. smoke box, but are otherwise generally similar to the shell filled T.N.T. that have been previously described.

As an alternative (Fig. 81), the above shell may be filled with amatol 60/40, cold pressed, with which is incorporated 8 oz. of No. 5 smoke mixture.

Inserted in the centre cavity in lieu of a smoke box, is an A exploder of C.E. or T.N.T. On top of the A exploder is inserted a B exploder of C.E. or T.N.T.

Two tracing cloth discs are placed between the top of the B exploder and the fuze or plug.

T.N.T. exploders may only be used when C.E. exploders are not available.

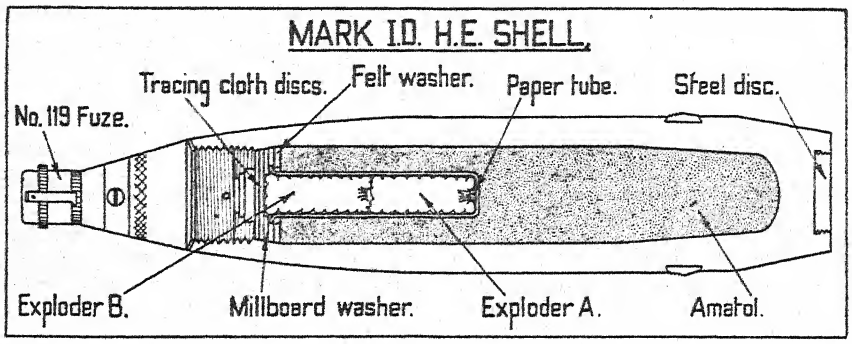


FIG. 81

Method of filling

High explosive shell with this equipment are filled with either T.N.T. or amatol, and are fitted with a suitable exploder system.

Before filling, the interior of the shell is varnished to ensure a smooth surface for the explosive, with a view to avoiding premature action.

The explosive T.N.T. is melted and poured into the shell in the fluid state and allowed to solidify in its place ; this is spoken of as poured filling.

With the explosive amatol, the shell consists of cold pressed 60/40 amatol.

With cold pressed filling the explosive is used in the dry powder form and pressed into the shell by hydraulic or other pressure. This process was used very extensively during the period of the 1914/18 war, for amatol only, and is known as cold pressed filling.

Care must be taken when filling shell by the pouring process that no cavities are formed by the contraction of the explosive on solidification, and in the case of the pressed fillings that the density of the explosive in the shell is most suitably arranged from the point of view of safety and efficiency.

When the explosive is cast or pressed into position in this manner it is somewhat inert and difficult to detonate. This factor forms a valuable safeguard in transport, loading and firing, but renders it necessary to introduce an intermediary between bursting charge and fuze, as the service fuze would have great difficulty in completely detonating the shell.

The intermediary is known technically as an exploder, and is arranged as follows:—

A cavity is formed in the bursting charge immediately below the fuze during the operation of filling. With shell containing a bursting charge of T.N.T., a $2\frac{1}{4}$-oz. smoke box is first inserted in the cavity, above this is inserted a B exploder of C.E. in the form of approximately 16·5 dr. of crystalline explosive in a small bag. The bag is packed fairly tightly, and when inserted in the shell, a certain amount of pressure is necessary to get the fuze fully home, in order to prevent the set back on firing. This is most important, as if the act of firing produces a gap between fuze and exploder, the efficiency of the shell will be very much impaired, even to the extent of producing "blinds." The fuze must be in immediate contact with the exploder at all times. For the same reason, the exploder bag must be inserted in the shell with the choked end downwards, i.e. away from the fuze.

Amotol-filled shell may introduce a special difficulty, by reason of the grade of T.N.T. used in the bursting charge. If crude T.N.T. is used and the storage temperature exceeds 70 degrees Fahr., certain oils are found to exude from the filling, which, if allowed free access to the exploder, will have the effect of rendering the exploder filling solid and inert, leading most probably to blind shell. To overcome this difficulty, such shell have the bursting charge and exploder separated by a moisture-tight barrier in the form of a paper tube impregnated with paraffin wax. To complete the sealing of the cavity, the top of the filling is sealed with a waxed felt washer, inserted whilst hot, and the lip of the tube is turned back and thus interposed

between the felt washer and a waxed millboard. This method has now been extended to T.N.T. fillings.

With shell containing a bursting charge of amatol, an A exploder of C.E., or T.N.T. (nominal weight C.E. 17·5 dr., T.N.T. 18·5 dr.) is first inserted in the cavity of the shell, above this is inserted a B exploder of C.E. or T.N.T. (nominal weight C.E. 15·5 dr., T.N.T. 16·5 dr.). Other amatol-filled shell have a 1½ oz. or 1¼ oz. smoke box and a B exploder.

The effects of exudation are very much less with C.E. exploders than with T.N.T. exploders, consequently the C.E. type should always be used if available, especially for shell destined for use in hot climates.

SMOKE SHELL

The *Mark IID*, B.E. streamline smoke shell (Fig. 82) has a radius of head of approximately 10 calibres and is of the base ejection type, the base below the driving band being gradually reduced in diameter to form a streamline. Near the base is an undercut groove with waved or knurled ribs, into which is pressed a copper driving band to design D.D.(L)6487A/2, which differs from D.D.(L)6487/2 in weight only (*see* Fig. 79).

The body has a cavity with parallel walls and is formed with a shoulder in the head to receive the baffle plate.

The head is fitted separately and is recessed and screw-threaded internally to the 2-inch fuze-hole gauge, and is provided with a C fixing screw, which also retains the fuze when in the shell. A tinned-plate disc is soldered over the hole in the bottom of the fuze socket.

A baffle plate of circular steel is positioned against the under side of the shoulder at the head and is perforated by a central flash hole. A paper disc is shellacked above the baffle plate.

The bottom of the shell is recessed to a slightly larger diameter than the cavity, screw-threaded internally and fitted with a steel base having a threaded brass ring sweated on. The base is screwed against a copper disc to ensure a tight joint, being retained by a C fixing screw.

Two keyholes are formed to facilitate insertion of the steel base. Millboard discs as required are shellacked to the inside of the copper disc.

The cavity of the shell contains three Mark I No. 3 smoke containers of S.R. composition, which are inserted in the shell, closing disc end first.

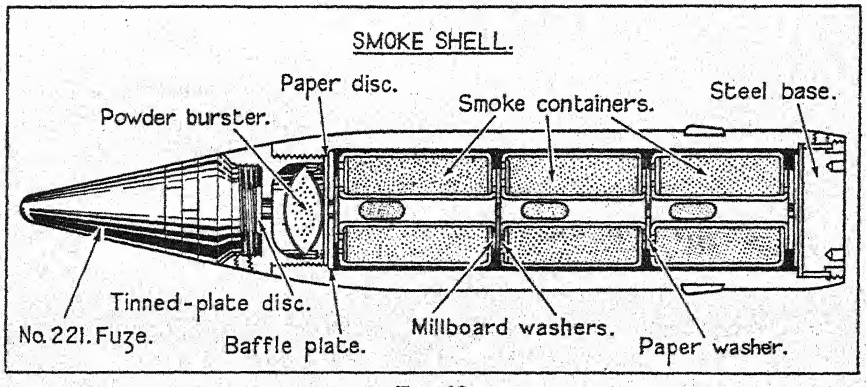


FIG. 82

Paper washers are shellacked and secured on the solid end of each container, whilst millboard washers are shellacked and secured to the closing disc end, also the solid end of each container, the bottom one being secured to the millboard discs and the top one to the baffle plate.

The method of filling with Mark II containers differs slightly from that described.

A 1½-oz. powder burster in a shalloon bag is placed above the baffle plate.

The fuze used with this shell is the T. and P. No. 221.

The shell are plugged with the Mark II or III No. 1, 2-inch fuze-hole plug. A leather washer is placed on the flange of the plug.

The threads of the plug, fuze and steel base, together with their fixing screws, should be coated with approved luting before inserting into the shell.

The nominal weight of the shell, filled and fuzed, is 21 lb. 13 oz.

With the base-ejection type of shell, the time fuze ignites the bursting charge, which, on explosion, ignites the composition in the canisters and blows off the base of the shell. The canisters fall to the ground and emit a dense volume of smoke whilst the contents are burning.

Two outstanding advantages claimed for this type of shell are greater safety in storage, as white phosphorus filling is not employed, and more efficient smoke production than that experienced with other types.

The *Marks IVD, VD and VID* B.E. streamline smoke shell differ principally from the *Marks ID, IID and IIID* in being fitted with a driving band to design D.D.(L)6487/7, and in the weight.

The *Mark IIID* streamline smoke shell differs principally from the *Mark IID* in having a cone seating for the separately fitted head.

The *Mark ID* streamline smoke shell are generally similar to the *Mark IID*, but some of the shell have the body and head combined in one forging.

The *Mark IA* smoke shell (Fig. 83) differs principally from the *Mark ID* in having a radius of head of 4 calibres. The cavity of the shell contains four smoke containers, while the driving band is to design D.D.(L)T.6487/2 instead of D.D.(L)6487A/2, the difference being in a slightly different taper and weight.

The nominal weight of the shell, filled and fuzed, is 25 lb. 1 oz. 4 dr.

The fuze used with this shell is the T. and P. No. 220.

The *Mark VIIB* B.E. smoke shell is generally similar to the *Mark VID* streamline smoke shell, differing principally in being rear-banded and in having a cylindrical base.

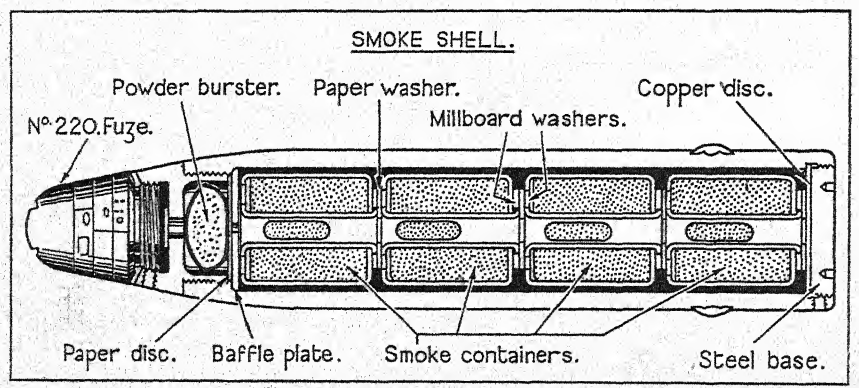


FIG. 83

ARMOUR PIERCING SHOT

The *Mark IT* armour-piercing shot (Fig. 84) is of steel, with 1·4 calibre radius head; it is 2·7 calibres long and the base is recessed and screwed to accommodate an internal tracer. The body is slightly radiused at the base above which is an undercut groove with waved ribs or alternatively knurled, to receive a copper driving

band, which is pressed into position and shaped externally to design D.D.(L)6487/3, which is similar in design to that shown in Fig. 79, only slightly different in contour. A No. 2 tracer is used with this projectile. It is obsolescent.

The *Mark IIT* armour-piercing shot is generally similar to the *Mark IT*, but the groove for the driving band is not undercut.

The *Mark IIIT* armour-piercing shot is generally similar to the *Mark II*, differing principally in the recess in the base being formed to accommodate a steel closing plate.

The *Mark VIT* armour-piercing shot is generally similar to the *Mark IIIT*, differing principally in the shape of the tracer cavity. It is obsolescent.

The weight of the shot when fitted with a tracer is 20 lb.

The *Mark VIIT* armour-piercing shot is generally similar to the *Mark VIT*, differing principally in having a penetrative cap.

The *Mark VIIIT* armour-piercing shot is generally similar to the *Mark VIT*, differing principally in the size of the tracer cavity.

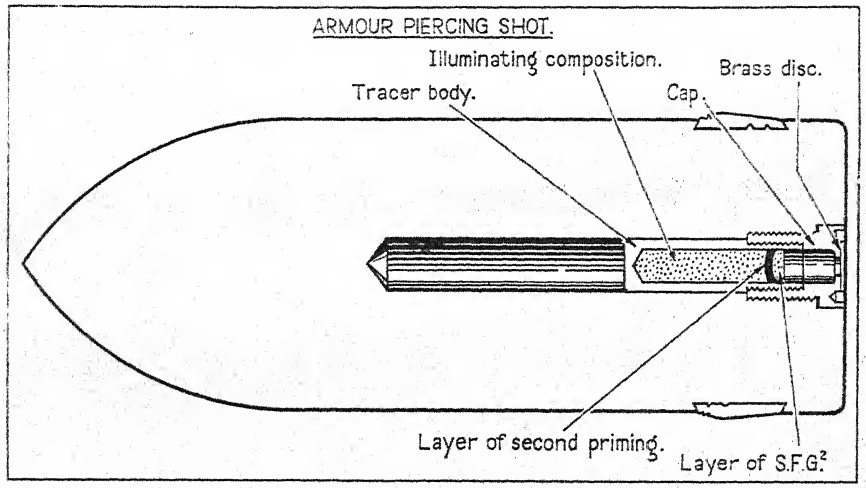


FIG. 84

PAPER SHOT

The *Mark I* paper shot consists of a brown paper body, sufficiently strong to stand loading, which is filled with sand. It is closed at the front end with strawboard discs and at the rear with strawboard washers and a cork bung. The exterior of the body is enlarged at the rear extremity to form a seal in the bore of the gun.

The shot is painted black, and when filled weighs 7 lb. It is intended to provide training in flash spotting and sound ranging, and for proofing the gun and recoil system. It will only be used on the authority, and under the supervision of, an E.M.E.

FUZES

FUZE, PERCUSSION, D.A., NO. 117

This fuze is a detonating fuse of the 2-inch fuze-hole gauge and is used with H.E. streamline shell when instantaneous effect is desired.

The *Mark III* fuze (Fig. 85) consists principally of a body, magazine with bottom cap, shutter with detonator, locking weight, guide bush, percussion and arming arrangements, striker cover and safety cap.

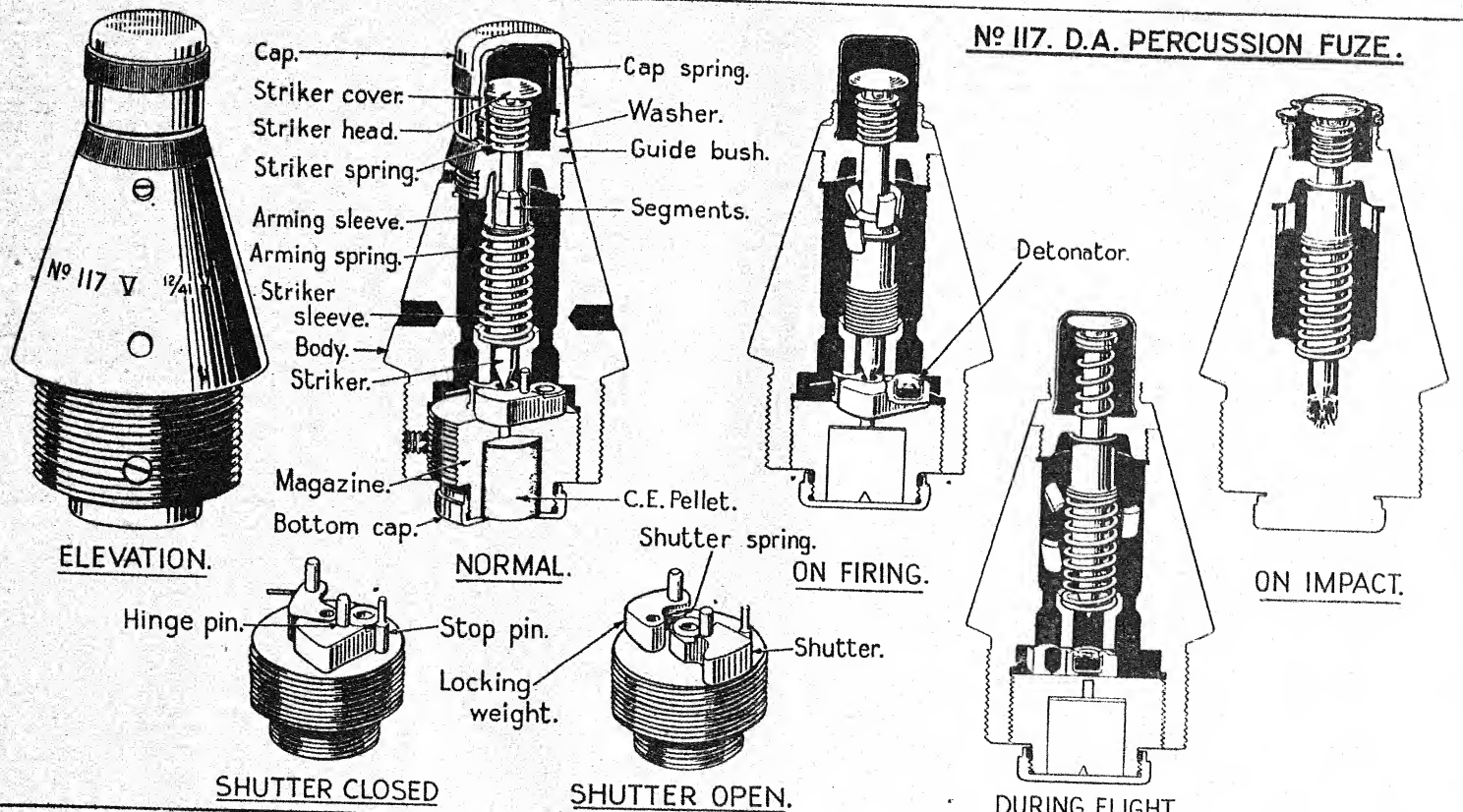

Nº 117. D.A. PERCUSSION FUZE.
Nº 117 V 12/41
Cap.
Striker cover.
Striker head.
Striker spring.
Arming sleeve.
Arming spring.
Striker sleeve.
Body.
Striker.
Magazine.
Bottom cap.
Cap spring.
Washer.
Guide bush.
Segments.
C.E. Pellet.
ELEVATION.
NORMAL.
Detonator.
ON FIRING.
ON IMPACT.
Hinge pin.
Stop pin.
Locking weight.
Shutter spring.
Shutter.
SHUTTER CLOSED
SHUTTER OPEN.
DURING FLIGHT

Fig. 86

The **body,** of brass, has the lower portion screw-threaded externally to the 2-inch fuze-hole gauge, and the upper portion, conical in shape, bored and screw-threaded internally to receive the guide bush, below which a plain portion receives the percussion and arming arrangements. Two holes are bored through the body diaphragm to connect the lower recess to the upper recess and act as vent holes to relieve pressure in the lower recess, should a detonator fire on the shock of discharge. One of these holes is situated immediately over the detonator when the shutter is closed. Two keyholes are formed in the side for fixing purposes.

The base is recessed to house the shutter and locking weight and screw-threaded to receive the magazine, a diaphragm being left in the body. The upper and lower cavities are connected through the diaphragm by a central boring to receive the point of the striker and two borings, diametrically opposite, which act as gas chambers. The upper end of the central boring has an annular recess to house the lower end of the arming spring to obviate the possibility of the spring being trapped under the flange of the striker spindle.

Recesses are formed in the under side of the body diaphragm to receive a hinge pin for the shutter and one for the locking weight, in addition to one for a pin for the fibre stop sleeve. To prevent the magazine from fouling the shutter by being screwed too far in, a distance pin is positioned in the shutter recess.

The **magazine,** of metal or zinc base alloy, is screw-threaded externally to suit the body. It is reduced in diameter at the bottom and screw-threaded to receive a bottom cap, which is crimped in two or more places, equidistantly spaced, after filling; the crimping, together with a set screw, is to lock the threads against unscrewing. The cap retains the magazine filling.

It is bored from the base in two diameters, the larger bore containing a C.E. pellet which is assembled with the hard end next to the bottom cap, a paper disc being shellacked to the top surface. The smaller bore is within a fraction of an inch of the top surface of the magazine, leaving a thin metal diaphragm, and is filled with stemmed C.E.

The **shutter,** of metal or mazak, is located between the upper face of the magazine and the under side of the body diaphragm.

It is bored through the centre for its hinge pin and prepared with a recess at one end to receive the detonator. The detonator consists of a copper alloy shell which is dropped into its recess; on it is placed a glazedboard disc and then a brass washer, the latter closing the detonator recess and held in position by the five lugs on the copper shell being turned over it.

The detonator contains 2 grains of detonating composition and 3 grains of lead azide.

A recess is formed in the side of the shutter, its face being machined to form a working surface for the toe of the locking weight. The end opposite the detonator recess is enlarged to form a weight to operate under centrifugal force.

The shutter is designed to open when the shell is spun between 1,800 and 2,200 revolutions per minute.

The **locking weight,** of metal or mazak, is an arc-shaped fitment located above the magazine and is forked at one end to receive the shutter spring and bored vertically for its hinge pin. The other end is formed with a toe which is machined to act as a working surface in the recess in the side of the shutter under the influence of the shutter spring, thus masking the central hole in the body diaphragm.

The upper surface of the toe is recessed to accommodate the point of the striker to prevent the shutter opening whilst the fuze is at rest and until acceleration has ceased in the gun.

The **guide bush,** of metal, is formed with a flange about its centre which is coned to suit the contour of the body and milled around its edge. It is screw-threaded externally above and below the flange, the upper to receive the safety cap and the lower to suit the top of the fuze body.

It is bored through the centre to form a guide for the striker, the upper end of the boring being enlarged to form a seating for the striker cover and spring.

The lower end of the boring is formed with a countersunk edge to bear against the segments.

A recess on the under surface forms a seating for the arming sleeve. A set screw locks the threads against unscrewing.

The **percussion and arming arrangements** consist of a striker with head, striker spring, striker sleeve, segments, arming sleeve and spring.

The **striker,** of steel, is in two parts, striker and head, secured together by a split pin.

The striker is a metal rod circular in section having a point at its lower end, above which is formed a flange against which bears the lower end of the striker sleeve. The upper end is reduced in diameter to fit the head and bored to receive a split pin.

The striker head is a mushroom-shaped fitment which is bored to fit the striker spindle, a radial boring accommodating the split pin. When assembled with its sleeve and segments the flange has a small clearance between its lower edge and the seating for the arming spring in the body diaphragm.

The **striker spring,** of steel, is circular in section and is assembled under initial compression between the striker head and the upper face of the guide bush. When the striker is released by the falling away of the segments the spring expands, so withdrawing the point of the striker out of the recess in the locking weight.

The **striker sleeve,** of metal, is cylindrical in shape and fits over the striker spindle, bearing against the upper face of the flange on the striker. The upper end is chamfered to bear against the lower countersunk edge of the segments.

The **segments,** four in number, form a hollow cylinder around the spindle and are assembled between the lower end of the guide bush and the upper end of the striker sleeve, and maintain the striker spring under its initial compression, until released by acceleration and centrifugal force.

The upper edge of the segments is chamfered, whilst the lower edge is countersunk, viewing the segments as a cylinder.

The **arming sleeve** is a hollow cylindrical brass fitment, the upper and lower edges being turned over to form bearing surfaces for the arming spring and under surface of the guide bush. The arming sleeve retains the segments in position until released by acceleration.

The sleeve is kept up to its work by an arming spring, which is assembled on the outside of the striker sleeve, one end bearing against the arming sleeve and the other in the recess in the upper face of the body diaphragm.

The **striker cover,** of brass, is dome-shaped and positioned over the striker head, being seated in the upper recess in the guide bush. The cover prevents the resistance of the air, during flight, acting on the striker head, so causing premature action of the striker.

This cover must not be removed when preparing the fuze before loading.

The **safety cap,** of steel, is dome-shaped and has a flat steel spring riveted into an oblique slot on one side. The free end of the spring engages in the milling on the guide bush and retains the cap in position. The cap is formed with a milled ring around its circumference and is screw-threaded internally at its lower end for attachment to the guide bush.

As an alternative the cap may be manufactured of zinc alloy, but is similar in shape to the steel cap. A warning label No. L.1914 is attached to the cap as under :—

IMPORTANT

When preparing this fuze for firing the black steel safety cap only is to be unscrewed and removed.

Action

On firing, the acceleration of the shell in the bore causes the arming sleeve to set back and compress the arming spring between itself and the bottom of the recess in the upper surface of the body diaphragm.

This movement uncovers the segments and, combined with a slight set-back of the striker, releases the four segments and permits them to fall clear. Should acceleration not displace the segments they will be positively displaced by centrifugal force.

During flight, as deceleration sets in, the striker spring, which is assembled under compression, reasserts itself against the under side of the striker head, forcing the striker and striker sleeve forward until the upper end of the sleeve meets the under surface of the guide bush, withdrawing the point of the striker out of the recess in the locking weight.

This allows the locking weight to revolve round its hinge pin under the action of centrifugal force. In doing so its toe starts the shutter turning on its hinge pin. This action is arranged to ensure that the shutter shall revolve into its armed position. The shutter is so shaped that centrifugal force can only cause it to revolve round its hinge pin gently and the locking weight gives it a start. Centrifugal force then continues to revolve the shutter gently till it reaches the stop pin, which locates the detonator under the striker point.

In this way shock to the detonator, when the shutter opens, is avoided. The stop pin is fitted with a fibre sleeve for the same purpose.

The fuze is now fully armed, the striker point being held clear of the detonator by the striker spring and the retardation of the shell due to air resistance acting on the mass of the striker.

On impact the striker cover is forced on to the striker head, the striker being forced inwards compressing the striker spring and causing the point of the striker to pierce the detonator. The resulting detonating wave passes through the magazine diaphragm to the small column of stemmed C.E. and thence *via* the C.E. pellet in the magazine to the bursting charge in the shell.

The *Mark IV* differs from the *Mark III* in being manufactured of steel. It is obsolescent.

The *Mark VI* is generally similar to the Mark IV, differing principally in the body being made of cast iron.

The *Mark VII* is generally similar to the Mark VI, differing principally in being modified to accommodate a more powerful detonator.

FUZE, D.A. AND PERCUSSION, NO. 119

This fuze is a combined direct action and non-delay graze fuze, fitted with a detonating magazine. It is used with H.E. shell and its D.A. mechanism will give instantaneous, above ground, effect at all ordinary ranges. Its inertia pellet mechanism enables it to act under conditions where the D.A. mechanism might fail. To distinguish it from the No. 117 D.A. fuze, there is a black band painted around the body and a knurled band for identification at night.

The *Mark VI* fuze (Fig. 86) consists of a body, magazine with bottom cap, shutter with detents and spring, magazine detonator with holder and plug, inertia pellet with detonator and plug, creep spring, striker with striker head, split pin and cover, detent with spring and plug, centrifugal bolt with plug and nose cap with spring, rivet and washer.

The **body,** of brass, is generally conical in shape and screw-threaded externally to the 2-inch fuze-hole gauge to fit the shell.

It is bored axially to receive the striker and inertia pellet and screw-threaded internally, at the lower end, to receive the detonator holder and magazine.

Four other longitudinal holes are bored upwards from the magazine recess; three of these are lightening and gas-escape holes, and the other, closed by a screwed plug, carries the detent and its spring.

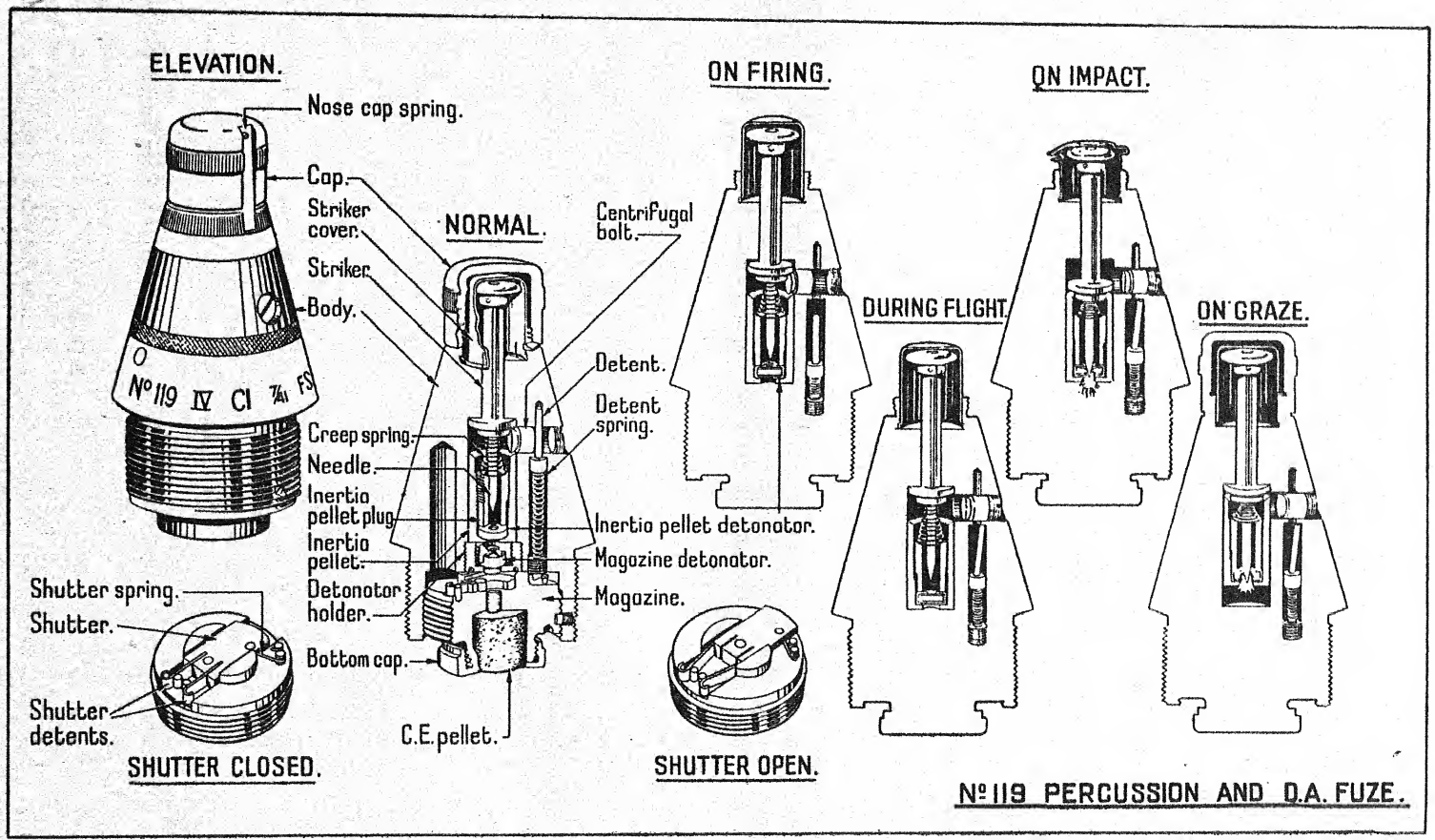

ELEVATION.
Nose cap spring.
Cap.
Striker cover.
Striker.
Body.
NORMAL.
Centrifugal bolt.
Detent.
Detent spring.
Creep spring.
Needle.
Inertia pellet plug.
Inertia pellet.
Detonator holder.
Bottom cap.
C.E. pellet.
Inertia pellet detonator.
Magazine detonator.
Magazine.
Shutter spring.
Shutter.
Shutter detents.
SHUTTER CLOSED.
SHUTTER OPEN.
ON FIRING.
DURING FLIGHT.
ON IMPACT.
ON GRAZE.
Nº 119 PERCUSSION AND D.A. FUZE.

Fig. 86

Positioned in a radial channel is the centrifugal bolt, the inner end of which is interposed between the inertia pellet and the flange of the striker, so long as its outward movement is prevented by the detent. The outer end of the radial channel is closed by a screwed plug, the threads of which are treated with cement to make a watertight joint.

The **magazine** is common to several fuze designs. It may be of brass, zinc alloy or aluminium alloy and is screw-threaded externally to enable it to be screwed into the body and is afterwards prevented from rotation by a set screw.

The magazine is bored from the base in two diameters, the larger bore containing a C.E. pellet and the smaller channel filled with stemmed C.E., which is only separated from the shutter recess by a very thin skin of metal called the diaphragm. The bottom of the magazine is closed by a cap, often of zinc alloy, screwed on and secured by crimping.

The top surface of the magazine is slotted to carry the sliding shutter and detents. It has two upstanding projections to prevent the magazine being screwed in too far and the shutter being jammed. It carries two small pins to locate the two detents, and two other pins which form bearings for the shutter spring. When the magazine is manufactured as a pressure die casting of zinc alloy the pins are of somewhat similar shape, solid with the magazine. There are two keyholes bored in the under surface of the magazine for the application of a key for insertion and removal.

The **shutter,** of brass or zinc alloy, has a hole bored through it at one end, from top to bottom, containing stemmed C.E. kept in position by paper tablets secured by shellac. Towards the other end another hole is bored and connected to a side hole or slot through which projects one end of the shutter spring. So long as the fuze is at rest this spring keeps the shutter pressed against two detents of flat brass strip, and with the stemmed C.E. channel well off the centre line of the fuze, i.e. the solid part of the shutter is between the detonator and the stemmed C.E. in the magazine.

When the fuze is spinning, the shutter remains closed up to 1,300 revolutions per minute, but opens before the speed exceeds 1,700 revolutions per minute. When open, the stemmed C.E. in the shutter is directly in line with the detonator and the shutter detents are clear of their slots in the shutter. This allows them to swing about their outer ends and prop open the shutter against closure on shock of impact.

This action can only take place when the fuze is spinning. If the fuze should be dropped in such a way that the shutter opens, the detents follow the shutter and in consequence do not get out of their slots and do not prevent the immediate return of the shutter under the influence of its spring.

The **detonator holder** carries the main detonator secured by a screwed plug, and below the detonator there is a little C.E. stemmed in and secured by a paper patch.

This detonator contains 5 grains of A.S.A. composition and is closed by a paper disc and silk gauze disc, so that it is readily fired by the flash from the detonator in the inertia pellet.

The **inertia pellet,** of brass, carries a 3-grain igniferous detonator held in position by a screwed brass plug in the form of a sleeve which surrounds the point of the striker.

The **creep spring,** of steel wire, is interposed between the flange of the striker and the inertia pellet, for the purpose of keeping the inertia pellet down on its seating during flight. It lightly grips the stem of the striker so as to facilitate assembly of the fuze.

The **striker,** of steel, projects above the metal of the body and to increase sensitivity, is fitted with an enlarged head secured by a split pin. Near its middle it has an external flange of which the under side is shaped so as to engage the inner end of the centrifugal bolt.

The **centrifugal bolt,** of steel, is cylindrical, its inner end being shaped to suit that of the striker flange.

The **detent,** of metal, is in two parts attached together by a ball and socket joint. This allows the stem to rock over independently of the socket portion.

A **striker cover,** of sheet brass, is sprung into a recess in the front of the body and covers the head of the striker. It prevents air pressure, during flight, acting on the striker and *must on no account be removed when preparing the fuze prior to firing.* A warning label, DO NOT REMOVE, is shellacked to its front end.

The **cap,** of steel, must always be kept in place until the fuze is being prepared for firing. It protects the striker from chance blows and, by being screwed down firmly on to its leather washer, keeps the fuze watertight. A flat steel spring is riveted to the cap and its lower end, engaging milling on the fuze body, prevents the cap becoming unscrewed.

An instruction label, as under, is attached to the cap :—

THE CAP SHOULD BE LEFT ON WHEN THE TARGET IS BEHIND COVER.

Unlike any other service fuze it is permissible to fire this fuze with its steel cap in position in order to prevent instantaneous action and thus to obtain a short delay when attacking a target behind light cover or to obtain crater effect in soft ground.

Action of fuze

On firing.—Acceleration of the shell causes the detent to move back, compressing its spring. Its stem tilts under centrifugal force and engages under the shoulder of the detent hole so that it cannot interfere with the movement of the centrifugal bolt.

The striker also sets back as far as the centrifugal bolt will permit and the coned surface of the striker flange engaging the coned surface of the bolt prevents movement of the latter.

The shutter stays in the closed position due to friction set up by acceleration. This ensures that the shell will not premature should either detonator fire under shock of discharge.

When acceleration dies away, in general just outside the muzzle, the striker moves forward, helped by the thrust of the creep spring. This raises the flange of the striker off the centrifugal bolt, which moves clear under centrifugal force. There is now only the thrust of the creep spring keeping the striker and inertia pellet apart.

The shutter also spins open, bringing its stemmed C.E. immediately below the detonator and above the thin diaphragm of the magazine.

The inner end of the shutter detents move outwards and lock the shutter in the open or armed position.

During flight there is a tendency for the inertia pellet to creep forward owing to deceleration of the shell due to air resistance, but such movement is prevented by the creep spring.

On impact, cap off, the striker cover is crushed in. The striker being forced inwards, overcomes the creep spring and causes the striker point to pierce the igniferous detonator in the inertia pellet. The flash fires the main detonator and this initiates detonation of the stemmed C.E., the magazine pellet and the bursting charge of the shell.

At small angles of arrival the striker may not be driven in and the fuze will act on graze only, as described in the next paragraph.

On impact, cap on. Against light cover the cap renders the striker inoperative and the fuze will act on graze only, the inertia pellet moving forward on to the striker and causing the igniferous detonator to fire. In comparison with the instantaneous action of the striker there is a small inherent delay when the inertia pellet acts alone.

The Mark III is the Mark I with a detent spring similar to that in the Mark IV.

The Mark II approximates to the Mark IV, but has the body of zinc alloy instead of brass and has a large figure 2 painted on the body in white.

Because of the use of the weaker zinc alloy material, the recess at the front end of the body is reduced in diameter to give the necessary strength of wall at this point. This entails the use of a striker cover and striker head smaller in diameter than those used in the Mark IV fuze.

The Mark I has a stronger detent spring and no head to the striker.

The letter A after Marks I and III denotes the fitting of an enlarged head.

The letter B after Marks I and III denotes the fitting of a striker cover with a stiffer top.

NOTE 1.—In some fuzes the striker is in two parts, the front portion fitting into a socket in the rear portion and is prevented from falling out by the striker cover.

NOTE 2.—The weight group into which a fuze falls, because of the materials used in its construction, is shown by special marking on the body. *See* Chapter VI.

FUZE, PERCUSSION, D.A., NO. 117C

This fuze is converted from the No. 119 type and has been introduced as a temporary expedient and will in due course drop out of the service.

It is a detonating fuze and used with H.E. streamline projectiles when instantaneous effect is desired.

To cancel the significance of the knurled band around the body distinguishing the No. 119 fuze from the No. 117, a 1-inch band of yellow approved composition is painted around the body.

The *Mark IV* fuze is the Mark IV No. 119 fuze converted by removing the inertia pellet, inertia pellet detonator, detonator holder, detonator holder plug and magazine detonator and replacing them by a detonator holder, detonator plug and detonator of a different pattern ; in addition, the creep spring is lengthened.

The **detonator holder,** of brass, is screw-threaded externally at its lower end to suit the lower end of the body above the safety shutter and reduced at its upper end to fit the inertia pellet chamber. It is bored centrally in three diameters, the upper being screw-threaded to receive the detonator plug whilst the lower contains stemmed C.E. secured by a brass disc, the disc being retained by the edge of the holder being burred over the disc. The centre boring contains the detonator.

The **detonator plug,** of brass, is in the form of a hollow cylinder which is screw-threaded externally to fit into the top of the detonator holder to retain the detonator in position, a screwdriver slot being formed in its upper surface for insertion and removal. The upper end of the central boring is countersunk to allow for the entry of the striker.

The **detonator** is a copper alloy shell containing 2 grains of detonating composition and 3 grains of lead azide closed at the top by a brass disc and a brass washer, both being retained in position by five lugs on the shell being turned over the washer.

A shalloon disc is secured inside the bottom cap by shellac.

Action of fuze

On firing, the acceleration of the shell in the bore causes the detent locking the centrifugal bolt to move downwards. Its stem tilts under centrifugal force and engages under the shoulder in the detent hole. It is thus prevented from returning through the small hole before the centrifugal bolt has moved out.

The flange on the striker sets down on to the end of the centrifugal bolt. The sloping surfaces are designed to delay the release of the bolt which can only spin out when the striker moves forward again. It is forced forward by the bolt as the latter moves outwards.

The rotation of the shell causes the centrifugal bolt to move outwards away from the vicinity of the flange on the striker, leaving the striker free to move on impact. The shutter remains in the closed position due to friction set up by acceleration.

This ensures that the fuze will not premature should the detonator fire on the shock of discharge, as the stemmed C.E. channels will not be in line, and the diaphragm above the lower stemmed channel will still be covered.

During flight the friction on the shutter becomes less with deceleration and the rotary movement of the shell causes the shutter to move outwards by centrifugal force, so releasing the detents from their slots and bringing the loose stemmed C.E. in the shutter in line with the detonator and small bore of the magazine.

On impact, the striker cover is crushed in. The striker being forced inwards, overcomes the creep spring and causes the striker point to pierce the detonator. The resultant flash passes through the columns of stemmed C.E. to the C.E. pellet of the magazine, and finally to the bursting charge of the shell.

The *Marks IIIA, III, II, IA and I* fuzes are converted from identical Marks pertaining to the No. 119 fuze.

FUZE, TIME AND PERCUSSION, NO. 222

(Fig. 87)

This is a 2-inch fuze-hole gauge detonating time and percussion fuze of the double-banked tension type, which has a similar external contour to that of the Nos. 117 and 119 with the cap off. It is a type of fuze which is used for air burst ranging.

It consists principally of a body, bottom and top rings, inertia pellet and needle with creep spring, centrifugal bolt, top cap, detent and spring, time needle and spring, magazine, shutter with detents and spring, main, percussion and time detonators, each with a holder, and bottom cap.

The **body,** of brass, is formed with a platform which is chamfered to conform to the external contour of the fuze. The platform is graduated in tenths from 0 to 22 around the major portion of its chamfered periphery. A recessed safety mark, which is coloured red, and the word SAFE appear on the ungraduated portion midway between the figures 0 and 22, and a recess to take a fixing key is prepared between the figure 0 and the safety mark.

Below the platform the body is screw-threaded externally to the 2-inch fuze-hole gauge and a hole is prepared through the screw threads to take a set screw that secures the magazine when assembled.

The upper portion of the body above the platform is reduced in diameter and is screw-threaded externally at the top to take the top cap.

Internally the body is recessed from the bottom to take the detonator supporting plate and the magazine with shutter, the magazine being screwed into position. Five vertical borings in the body, above the recess, and three screw-threaded holes, are prepared to take the screws that secure the detonator supporting plate. The central boring, which is screw-threaded at the bottom to take the main detonator holder, communicates, by means of a small hole, with a similar boring from the top of the body which contains the inertia pellet, creep spring and percussion detonator. This upper boring is enlarged and screw-threaded at the top to take the percussion detonator holder. Of the remaining four borings, all of which are blind, one contains the time needle, spring and detonator, another the detent and detent spring, while the other two serve as gas expansion chambers.

The detent boring is reduced in diameter at the top to suit the stem of the detent.

A blind radial boring for the centrifugal bolt is made from outside the top of the body through the central boring into and past the small boring for the stem of the detent. When the fuze is assembled the entrance to this boring is closed by a screwed plug.

The boring containing the time elements communicates with the filling in the top ring by means of a horizontal and a diagonal channel which are drilled in the body.

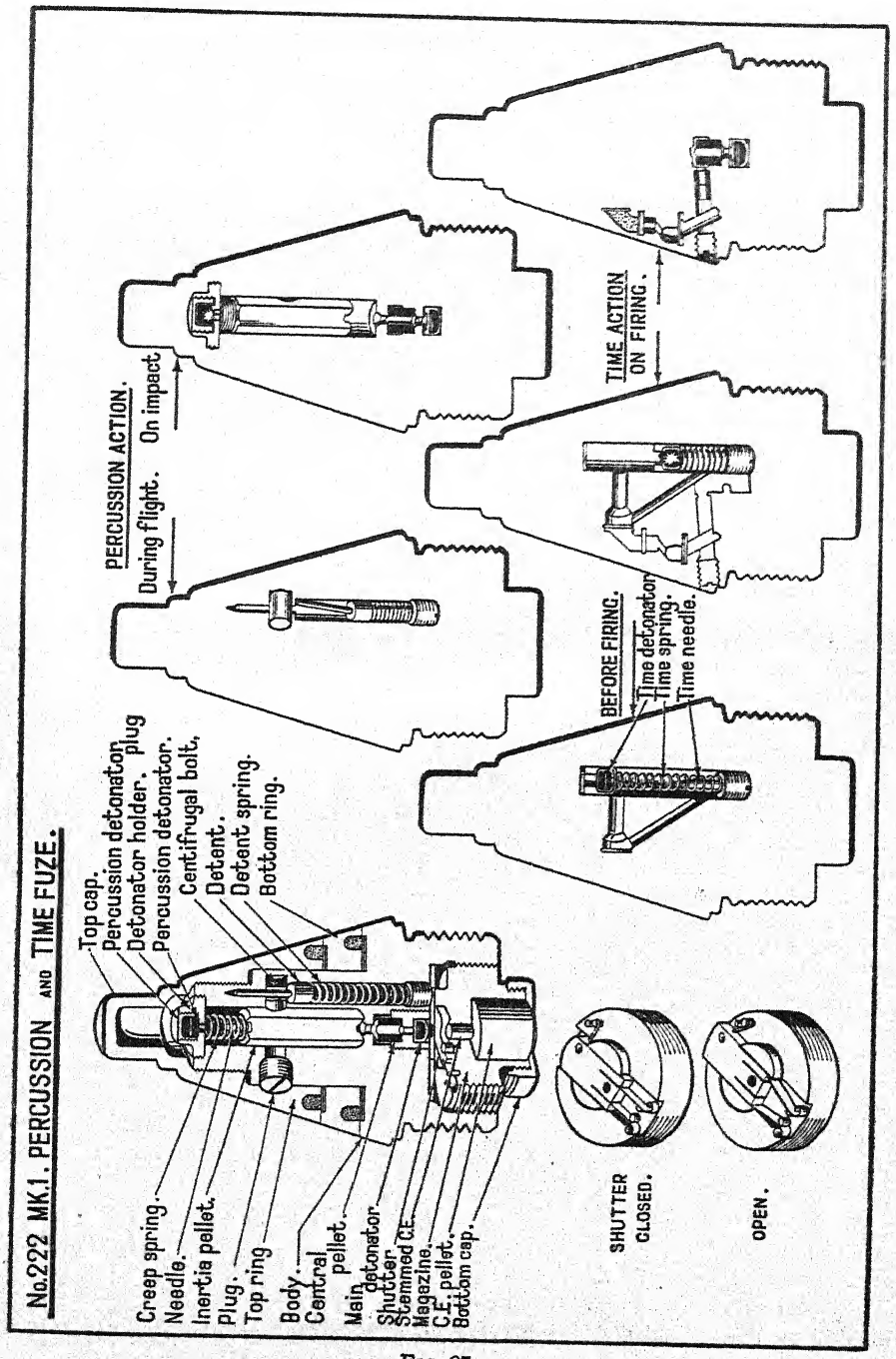


FIG. 87

A channel, drilled from outside the platform, in the vicinity of figure 0, communicates with a recess above the main detonator, and also, by means of a diagonal channel, with the bottom ring. The recess and channels contain powder pellets which convey the flash from the composition in the bottom ring to the main detonator. The entrance to the channel in the platform is closed by a screwed plug.

A recess in the top surface of the platform contains a box-cloth washer which is secured with shellac. A hole is left in the washer to expose the upper surface of the powder pellet in the diagonal channel.

The borings containing the detent and time arrangements are each screw-threaded at the bottom to take a detent plug and a time needle respectively, which serve to close the entrances to the borings.

The **bottom ring,** of brass, fits around the body above the platform and is free to turn. A semicircular channel in the under side of the ring is almost filled with fuze powder and the bottom surface of the ring is then covered by a paper washer. A small hole drilled from the top face of the ring communicates by means of a short channel, with the fuze powder in the under surface of the ring. The hole contains a powder pellet which conveys the flash from the top to the bottom ring. Another pellet, inserted in an escape hole which is drilled in the ring from the exterior, is in contact with the afore-mentioned pellet. The exit from the escape hole is closed by an asbestos pad, an asbestos escape disc and a brass escape disc, all of which are secured with shellac. The brass disc is additionally secured to the exterior of the ring by four chisel punch stabs.

A cloth washer is secured with shellac in a recess formed in the top face of the ring, a small hole being made in the washer to expose the top of the powder pellet.

The **top ring,** of brass, fits around the body above the bottom ring and is prevented from turning by a brass securing pin which is inserted in a hole, half of which is formed in the body and half in the top ring. The under surface is filled and prepared in a similar manner to that of the bottom ring. A channel, filled with mealed powder, connects channels from the time element boring with the fuze powder in the under side of the ring.

The exit of the gas-escape hole in the top ring is closed by a brass disc which is secured in position with shellac and two chisel punch stabs.

The **inertia pellet,** of brass, is cylindrical in shape and has two vertical grooves, semicircular in section, in the outer surface. The grooves are 180 degrees apart and are connected to each other at the top and bottom by a rectangular and semi-circular slot respectively, the slots being cut across the width of the pellet. For a portion of its depth, the pellet is bored and screw-threaded centrally from the top to take a steel needle which is secured with cement and by stabbing. A circular recess for the centrifugal bolt is prepared in the side of the pellet midway between the two vertical grooves. With the needle uppermost the pellet is inserted from the top into the central boring of the body, being followed by a steel creep spring which surrounds the needle and rests on top of the pellet.

The top of the boring is closed by a brass percussion detonator holder which is screwed into position above the creep spring. The holder is bored and screw-threaded centrally to take a brass percussion detonator plug, which contains a 2·5 gr. percussion detonator filled with powder and detonating composition. A small hole through the base of the detonator holder gives the needle access to the detonator in the plug from which it is withheld by the creep spring.

The **centrifugal bolt,** of metal, is cylindrical in shape and has a semicircular slot in one end to suit the stem of the detent. It is inserted into the boring prepared for it in the body with the slotted end protruding into the boring for the detent and the other end engaging within the recess in the side of the inertia pellet. The entrance to the boring in the body is then closed by a brass screwed plug.

The **top cap,** of brass, is screwed to the top part of the body above the top ring and, after the fuze has been correctly tensioned, is secured in position by a steel set screw which is screwed hard home and then stabbed.

The **detent,** of metal, consists of a stem with a sphere at the lower end, the sphere being accommodated within a socket which is dimensioned externally to fit the lower portion of the detent boring and internally to ensure such a fit for the sphere

as to permit free movement of the stem within prescribed limits. The detent is inserted into the appropriate boring with the stem, which is uppermost, situated within the slot in the centrifugal bolt and the boring of lesser diameter prepared for it.

The detent spring, of steel wire, is inserted after the detent, and the boring is then closed by a brass detent plug, which is screwed into the bottom of the boring and secured with cement and by stabbing.

The **time detonator holder,** of metal, is cylindrical in shape and has a boring of two diameters through the centre. The boring of greater diameter contains a 2·5 gr. detonator, similar to that already described, whilst the lesser boring serves as a flash hole for the detonator.

The holder is inserted into the time element boring in the body with the detonator downwards, a boxcloth disc having previously been secured with shellac to the blind end of the boring.

A time spring, of steel wire, is inserted after the holder and the open end of the boring is then closed by a steel time needle, which is screwed into the boring and secured by stabbing, the striker portion of the needle, pointing upwards, being situated within the coils of the spring which bears against the detonator holder at the top and the shoulder of the needle at the bottom.

The **main detonator holder,** of brass, is cylindrical in shape and is screw-threaded externally. It is recessed internally at the top and bottom, the two recesses communicating with each other by means of a central hole which is enlarged at the top by a chamfer. The upper recess contains a perforated powder pellet and the lower a cloth washer followed by a 5-gr. detonator filled with A.S.A. composition. The holder is screwed into the lower portion of the central boring and secured by stabbing.

The **detonator supporting plate,** of brass, is circular in shape and is prepared with three countersunk holes to take the screws that secure it to the body. The top surface is recessed centrally, the upper portion of the recess being of increased diameter. The whole of the recess is filled with stemmed C.E., which is covered by a paper disc secured to the plate with shellac.

The plate is secured by screws to the top of the large recess in the lower portion of the body, so that the stemmed C.E. is immediately below the main detonator, and a kidney-shaped orifice through the plate is in a position that will permit the gases, resulting from the explosion of the fuze, to gain access to the gas-expansion chambers in the body.

The **magazine** may be of brass, aluminium alloy, zinc base alloy or any other approved material, and some magazines may differ slightly from others in minor details of design and dimensions.

It is cylindrical in shape and is screw-threaded externally to suit the threads in the lower recess of the body, in which it is secured in position by a set screw.

The lower portion of the magazine is reduced in diameter and screw-threaded externally to receive the bottom cap, and above this portion are two keyholes to facilitate assembly in the fuze.

The magazine is bored from the base in two diameters, the upper and smaller boring, which is filled with stemmed C.E., being separated from the shutter recess by a thin partition of metal which is known as the diaphragm. The large recess contains a pellet of C.E.

The upper surface of the magazine has two projections which limit the amount that the magazine may be screwed into the body and so prevent jamming of the shutter. Between the projections a slot is prepared to accommodate the shutter and its detents. Four holes are provided in the upper surface to take two detent locating pins, one spring retaining pin and one spring locating pin.

The **shutter** may be of brass, zinc base alloy or other approved material, and some shutters may differ slightly from others in dimensions and minor details of design.

It is the sliding type and is in the form of a rectangle with smooth, flat side and bottom faces. One end is rounded and the other is prepared with two slots to accommodate the stems of two shutter detents. A vertical hole containing stemmed C.E. is located between the slots, the C.E. being retained in the hole by top and bottom paper tablets. Another vertical hole, near the rounded end, communicates with a hole or slot in the side of the shutter, in which is inserted the inner end of the shutter spring.

The shutter serves to isolate the main detonator from the magazine until the projectile is clear of the bore.

The **shutter spring,** of steel, has its coil around a locating pin and its outer end bearing against a retaining pin, in which a groove has been prepared for it. Whilst the fuze is at rest the spring serves to keep the shutter pressed against the shutter detents with the hole containing C.E. clear of the centre line of the fuze, so that a solid portion of the shutter is interposed between the main detonator and the magazine. The restraint of the spring ensures that the shutter will not open under the action of centrifugal force until the fuze is spinning at over 1,300 and below 1,700 revolutions per minute, thus preventing a premature in the gun, should the main detonator fire before the shell is clear of the muzzle. Should the shutter be opened by any action other than that of centrifugal force the action of the spring will return the shutter to the safe position once more.

The **shutter detents,** of flat brass, are situated in the slot cut in the upper surface of the magazine, for the shutter. The stems of the detents are accommodated in the slots in the shutter and their outer rounded ends are located between the sides of the magazine and their respective locating pin. When the shutter is opened by centrifugal force the detents swing about their outer ends until the ends of the stems bear against the slotted end of the shutter and thus prevent it from closing again on the shock of impact. Should the shutter be opened by any action other than that of centrifugal force, e.g. as the result of being dropped, the detents move with the shutter, the stems remaining within the slots, and so do not prevent the shutter from being closed again by the action of its spring.

The **bottom cap,** like the shutter and magazine, may be of any approved material. It is screw-threaded internally to suit the threads at the bottom of the magazine, and after assembly is further secured by crimping.

During assembly the spaces between the time rings, body and top cap are filled with waterproofing composition and the screw threads are coated with approved cement in order to ensure that the fuze is watertight.

Action of fuze

Before loading

The fuze cover is removed and the fuze is set to detonate the shell at a certain predetermined time after firing. The fuze is set by turning the bottom ring by means of the fuze key, or in a fuze setter, until the setting mark on the ring is pointing to the graduation required.

On firing

Shutter

The shock of discharge causes the shutter to set back and it remains closed due to the friction set up by the acceleration imparted to the shell in the bore, thus ensuring that, should the main detonator be fired by the shock of discharge it will not cause a premature detonation of the shell in the gun.

Time portion

The shock of discharge causes the time detonator holder to set back, overcoming its spring and carrying the time detonator on to the time needle. The resulting flash from the exploding detonator passes through the channels connecting the time element boring and the top ring, igniting the fuze powder in the top ring.

Percussion portion

The shock of discharge causes the detent to set back, overcoming the spring and withdrawing its stem from the slot in the centrifugal bolt.

During flight

Shutter

When acceleration ceases, and the shell is clear of the bore, centrifugal force causes the shutter to move outwards, away from the shutter detents, until the hole stemmed with C.E. is brought immediately below the main detonator. The shutter detents pivot on their rounded ends and their stems fly outwards to engage against the end of the shutter and thus prevent the shutter being closed again by force of impact or any other cause.

Time portion

The fuze powder in the top ring is ignited, the metal disc covering the gas-escape hole is blown out, and the powder burns until the powder pellet in the bottom ring is reached and ignited. The discs and pad covering the gas-escape hole in the bottom ring are blown out, the composition in the ring is ignited and burns in the reverse direction to that in the top ring until the pellet is reached in the channel leading to the larger pellet above the main detonator. The pellets are ignited and fire the main detonator, the resulting detonating wave passing *via* the C.E. in the detonator supporting plate and shutter to the C.E. pellet in the magazine and thence to the shell filling.

Percussion portion

When the shell is clear of the bore centrifugal force causes the detent to tilt and the top of the detent stem engages under a shoulder in the detent bore below the position of the centrifugal bolt. The bolt is then free to move outwards under the action of centrifugal force, and withdraws from the recess in the inertia pellet. After the bolt has withdrawn the creep spring prevents the pellet from creeping forward, which it has a tendency to do owing to the retardation of the shell by air resistance.

On graze or impact

Percussion portion

When the fuze has been set to fire on percussion, or when, for any reason, the time mechanism fails to function or the shell strikes the target before sufficient time has elapsed for the time setting to operate the fuze, the inertia pellet overcomes the resistance of the creep spring and carries the needle on to the percussion detonator. The flash from the exploding detonator passes by way of the grooves in the inertia pellet to the powder pellet above the main detonator, and the resulting action is the same as that when the time portion of the fuze operates.

FUZE, TIME AND PERCUSSION, NO. 221

(Fig. 88)

This fuze is a double-banked tension fuze of metal with a cover used with smoke streamline shell.

The fuze consists of the following parts :—

Body, bottom and top rings, cap, base plug, time needle pellet with needle and spring, percussion needle pellet with needle and creep spring, detent, detent spring and centrifugal bolt.

The **body** is formed with a flange or platform, below which it is screw-threaded to the 2-inch fuze-hole gauge. Above the platform is formed a short stem having the top reduced in diameter and screw-threaded externally to receive the cap. The flange of the body is graduated around its outer edge from 0 to 22.

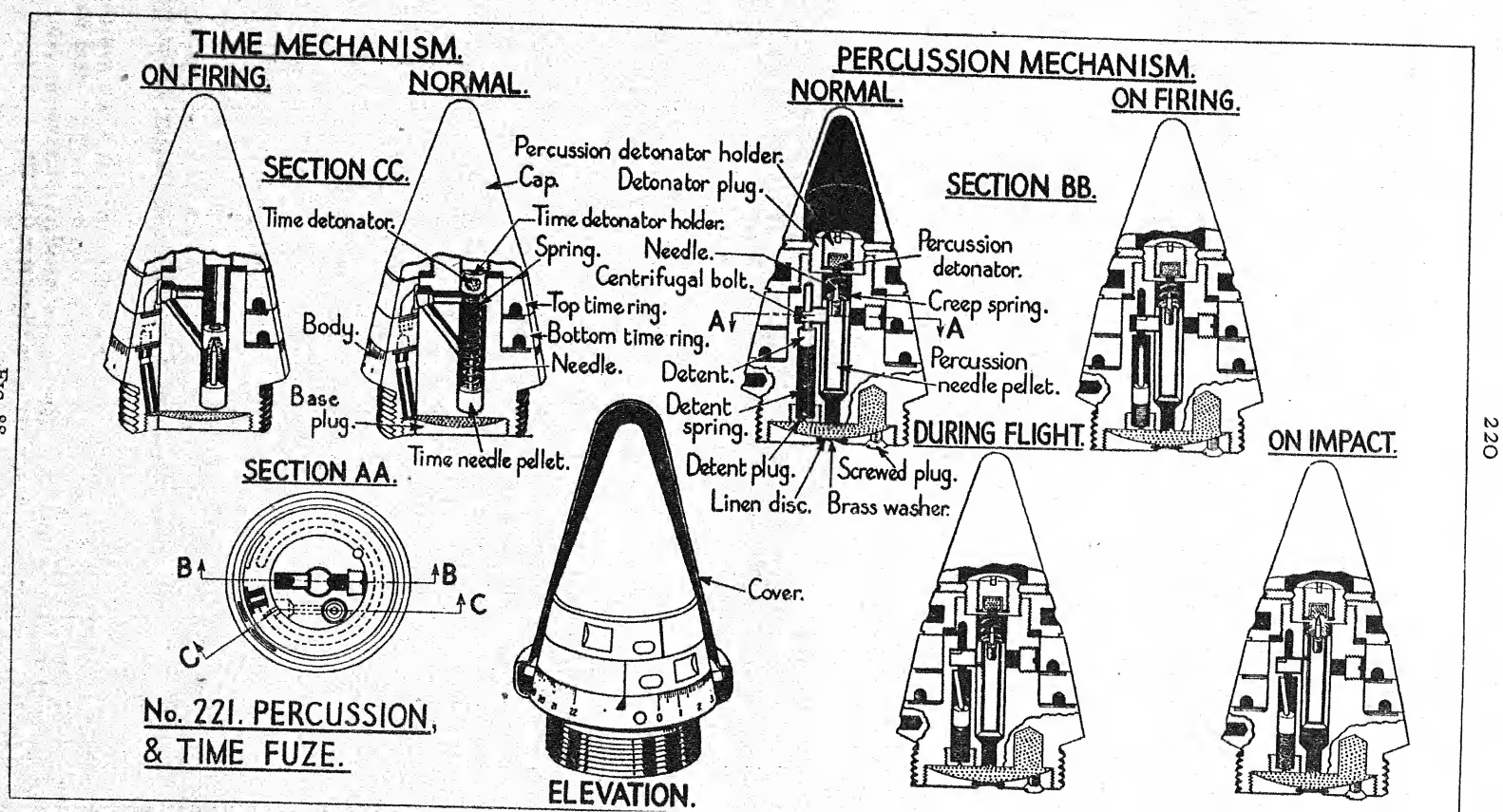

TIME MECHANISM.
ON FIRING.
NORMAL.
SECTION CC.
Time detonator.
Body.
Base plug.
Percussion detonator holder.
Cap.
Time detonator holder.
Spring.
Top time ring.
Bottom time ring.
Needle.
Time needle pellet.
SECTION AA.
B
B
C
C
PERCUSSION MECHANISM.
NORMAL.
ON FIRING.
SECTION BB.
Detonator plug.
Needle.
Centrifugal bolt.
Percussion detonator.
Creep spring.
A
A
Percussion needle pellet.
Detent.
Detent spring.
Detent plug.
Linen disc.
Screwed plug.
Brass washer.
DURING FLIGHT.
ON IMPACT.
Cover.
No. 221. PERCUSSION, & TIME FUZE.
ELEVATION.

FIG. 88

The stem is bored centrally from the top to receive the percussion arrangements and screw-threaded to receive the detonator holder and plug. The lower end is closed by a disc secured by shellac. An additional boring to one side of the central channel contains the time arrangement and time detonator, and is connected to the port on the outside of the stem by two oblique flash holes. The lower part of the body is bored and recessed to form a magazine and has an oblique and vertical channel connecting the magazine with the top of the platform and the bottom time ring.

The channels contain perforated powder pellets. A recess in the stem bored through the base receives the detent and detent spring and is closed by a screwed plug. A horizontal recess bored through from the side of the stem and connecting with the detent recess contains the centrifugal bolt, the latter locking the percussion arrangement in the safe position. The centrifugal bolt is prevented from moving outwards by the detent and spring. Keyholes are formed in the side of the platform for fixing purposes.

The **bottom ring** is bevelled on the outer edge and has a concentric groove filled in with R.D.202 pressed fuze powder nearly all round its under surface, a small recess being bored in the top surface coincident with the beginning of the groove and containing a perforated powder pellet, an oblique channel connecting the two.

A gas escape, having a perforated powder pellet, is provided in the outer edge. The ring is assembled over the stem of the body, round which it is free to revolve for setting purposes. The ring is lacquered red.

The **top ring** is similar to the bottom, but is of smaller diameter. The oblique channel leading from the concentric groove passes to the inner surface of the ring and, when the ring is assembled over the stem, the end of the channel is positioned to register with the port in the side of the stem. The ring is prevented from turning by a brass pin fitting into corresponding semicircular recesses cut in the ring and stem. The concentric groove is filled with 30-second powder.

The **cap,** of aluminium, is coned shaped, bored and screw-threaded to fit over the stem of the body. Two key recesses are formed in the sides for tightening the cap until sufficient tension is applied to the bottom ring. It is secured in position by two set screws.

The **base plug** has a central perforation which is closed by a brass washer and linen disc shellacked together, and provided with a filling hole closed by a screwed plug.

The magazine is filled with 60 gr. of G.20 gunpowder and is closed by the base plug. A copper and asbestos washer is fitted under the flange of the fuze.

Detonators

Both the time and percussion detonators consist of a perforated copper ball containing 1·1 gr. of detonating composition on top of which is about 1·4 grain of R.P. or G.20 gunpowder. The top of the detonator is closed by a copper disc having a fine white paper disc shellacked to it, and the bottom is closed by a brass or copper disc.

Time arrangement

The time detonator pellet is supported on the spiral spring and has the under side recessed to receive a detonator. The spring supports the detonator pellet, keeping the detonator clear of the needle until the shock of discharge.

Percussion arrangement

This consists of a needle, inertia pellet, creep spring and detonator contained in the central channel of the stem. The needle is prevented from moving forward by the inner end of the centrifugal bolt engaging in a recess in the side of the inertia pellet.

A **No. 5 cover,** of brass, for T. and P fuzes, is provided as a waterproof covering. It is cone-shaped and assembled over the fuze, being secured by a band which is pressed tightly round the fuze, and secured by a soft copper wire, the ends of which are twisted and tucked under the band.

Action of fuze

Before loading the cover must be removed.

Time arrangement

On firing, the time detonator pellet sets back, overcomes the resistance of the spiral spring, and carries the detonator on to the needle. The flame from the detonator passes through the flash holes in the stem to the top time ring, where it ignites the fuze powder and explodes the powder pellet in the gas-escape hole, blowing out the brass disc.

During flight the powder in the top ring burns round until it reaches the recess in the top surface of the bottom ring, explodes the powder pellet and ignites the powder in the bottom ring, at the same time clearing the gas-escape hole. The powder burns round in the opposite direction to that of the top ring until the channel leading to the magazine is reached. The flash passes to the magazine and thence to the bursting charge of the shell.

Percussion arrangement

On firing, the acceleration of the shell causes the detent to set back, compressing the detent spring and releasing the centrifugal bolt. The rotation of the shell causes the bolt to move outwards from its recess in the inertia pellet, leaving the pellet free to move forward on impact or graze.

During flight, the tendency of the pellet to move forward in consequence of deceleration will be checked by the creep spring.

On impact or graze, the pellet overcomes the creep spring and carries the needle on to the detonator. The resulting flash passes through the magazine, which is exploded should the time arrangement not have functioned during flight.

The total time of burning under normal atmospheric conditions at rest with fuze set at 22, is 50 seconds.

FUZE, TIME AND PERCUSSION, NO. 220

(Fig. 89)

The fuze is used with 4 c.r.h. smoke shell.

The *Mark III fuze* is almost identical with the No. 221 fuze, except for the cap, which is dome-shaped. The action of the fuze is similar.

The percussion arrangements are as described for the No. 221 fuze, whilst the time arrangements differ only in the top time ring, where the concentric groove is filled with 22 second powder.

The fuze is provided with a No. 6 fuze cover.

The total time of burning under normal atmospheric conditions at rest, with the fuze set at 22, is 46 seconds.

The *Mark II* differs from the *Mark III* in having a weaker creep spring.

The *Mark I* differs from the *Mark II* in being graduated from 0 to 44.

FUZE, TIME AND PERCUSSION, NO. 220B

The *Mark I* fuze is generally similar to the No. 220, differing principally in having a weaker detent spring.

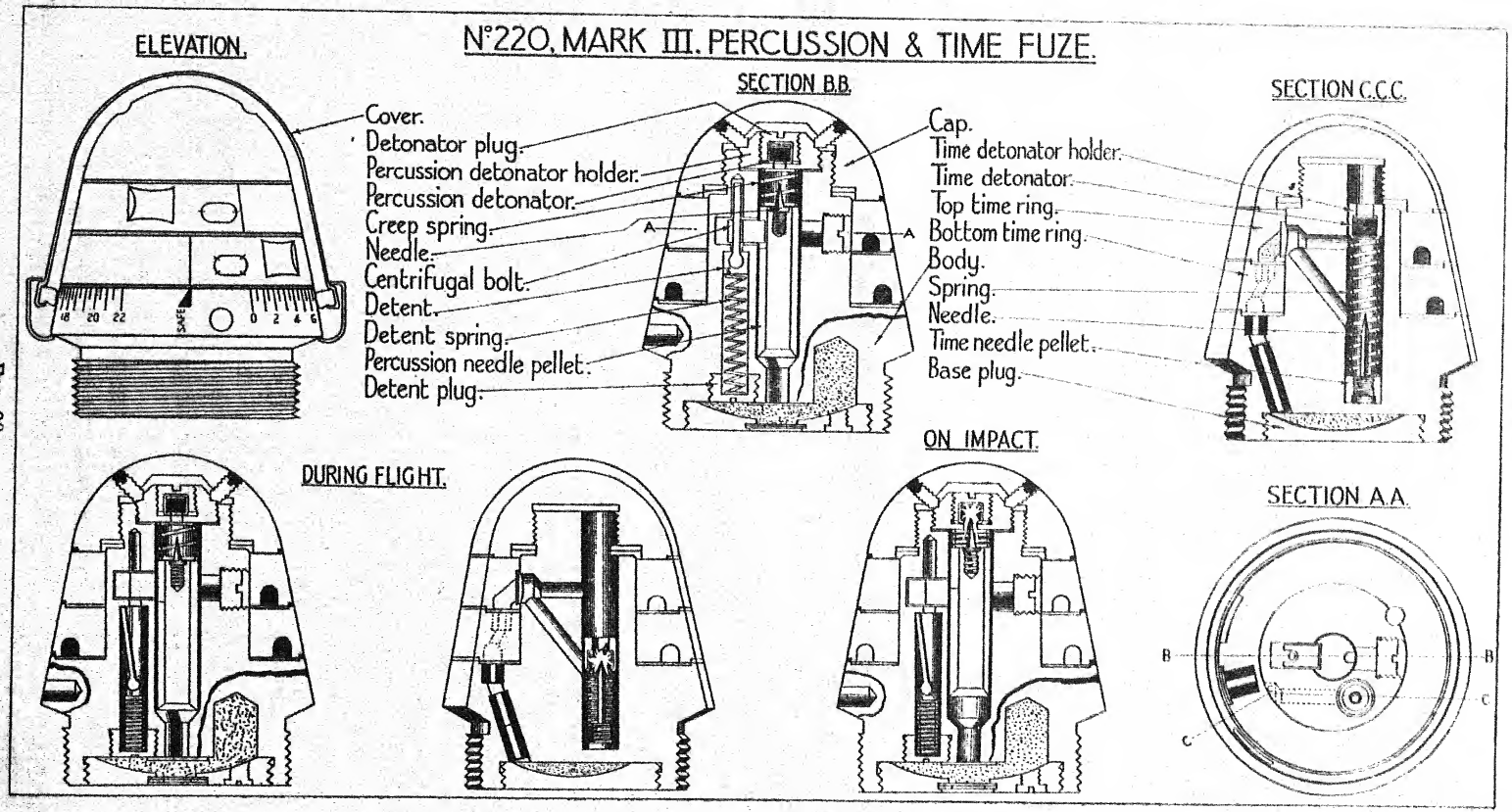

N°220, MARK III. PERCUSSION & TIME FUZE.
ELEVATION.
SECTION B.B.
SECTION C.C.C.
Cover.
Detonator plug.
Percussion detonator holder.
Percussion detonator.
Creep spring.
Needle.
Centrifugal bolt.
Detent.
Detent spring.
Percussion needle pellet.
Detent plug.
Cap.
Time detonator holder.
Time detonator.
Top time ring.
Bottom time ring.
Body.
Spring.
Needle.
Time needle pellet.
Base plug.
A
A
DURING FLIGHT.
ON IMPACT.
SECTION A.A.
B
B
C
C

FIG. 80

TRACER, SHELL, NO. 2

The *Mark VII* No. 2 tracer consists principally of a metal cap and body. The cap has a central boring and is screw-threaded internally to take the body and externally to suit the tracer cavity in the base of the projectile. A thin brass disc is sweated over the hole in the base and two slots are provided near the hole to take a fixing key.

The body has a central cavity containing about 50 grains of tracer composition S.R.247, in rear of which is a prepressed pellet in a tube of hard grey wrapping paper impregnated with paraffin wax. The pellet consists of 20 grains of S.R.247 and 5 grains each of S.R.247P and S.F.G.2 powder.

Externally the body is reduced in diameter at the rear end, where it is screw-threaded to suit the cap.

On firing the flash of the propellant passes through the centre of the cap to the filling in the body, thus igniting the pellet and illuminating composition in turn.

The Mark VII tracer is used in practice projectiles.

The Mark VIS tracer has a steel body and contains compositions S.R.261 and 261P instead of S.R.247 and 247P respectively. It is otherwise generally similar to the Mark VII and is used in service projectiles.

The Marks VI and IV have a different filling, but otherwise they generally resemble the Mark VII and, like it, they are used in practice projectiles.

PRACTICE AMMUNITION

PROJECTILE, PRACTICE, Q.F. STREAMLINE, 25-PR.

The *Mark ID* projectile consists of H.E. shell forgings converted and brought to weight by the addition of sand, the head being screw-threaded to receive a Mark III No. 1, 2-inch fuze-hole plug.

It is 12·87 inches in length, 3·44 inches in diameter over the body, and is 20 lb. in weight when painted, including driving band and weighting.

The *Mark IIDT* projectile is generally similar to the Mark ID but has no filling and is fitted with a 2-inch combined base plate and external tracer socket.

SHOT, PRACTICE, Q.F. 25-PR.

The *Mark IT* shot is of mild steel, and has a pointed nose, with a radius of 1·4 calibres. The base is recessed and screw-threaded to accommodate an internal tracer.

The driving band is to design D.D.(L)6487/3, which differs from D.D.(L)6487/2 only in being slightly wider.

The total weight, painted, including driving band and tracer, is 20 lb. The tracer used is the Mark VII No. 2.

The *Mark IIT* shot is generally similar to the *Mark IT*, but differs slightly in dimensions and principally in being of cast-iron.

The *Mark IIIT* practice shot is generally similar to the Mark IIT, differing principally in having a stemmed instead of a screwed tracer, and in the recess being formed to accommodate a steel closing plug.

The *Mark VT* is generally similar to the *Mark IIIT*, differing principally in having a modified tracer cavity. It is obsolescent.

The *Mark VIIIT* is generally similar to the *Mark VT*, differing principally in the size of the tracer cavity.

BLANK CARTRIDGES

CARTRIDGE, Q.F. BLANK, 25-PR.

The blank cartridge (Fig. 90) consists of a case, percussion primer, charge, silk cloth or cream serge bag and leatherboard cup.

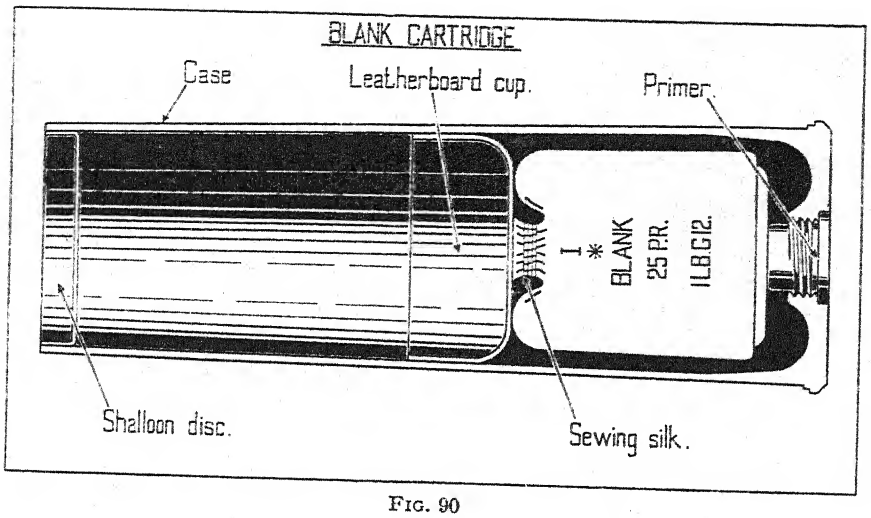


FIG. 90

The **case,** of solid drawn brass, tapers towards the mouth, with a hole in the base, screwed and recessed, to take the primer. A rim is provided by means of which the extractors of the breech mechanism automatically eject the empty case when the breech is opened.

The **primer** can either be a No. 1, Mark II or IIM, as described on page 194.

The **charge** consists of 1 lb. of blank L.G., G.12 or R.F.G.2 gunpowder in a silk or cream serge bag sewn with two rows of sewing silk and the mouth choked with double sewing silk. A bottom disc of undyed shalloon is sewn to the bag with two rows of sewing silk.

The *Mark II* **leatherboard cup** is inserted in the case and wedged against the charge base downwards, being secured with shellac.

A red shalloon disc is shellacked inside the mouth of the case to indicate that the case is filled.

DRILL AMMUNITION

The greatest care is necessary in the storage, handling and use of ammunition held on charge as drill, and every possibility of its being mixed with service or blank ammunition is to be avoided, as errors of this kind may lead to serious accidents.

CARTRIDGE, DRILL, Q.F. 25-PR.

The drill cartridge (Fig. 91) consists of an empty steel case into which is placed a charge in three portions made up of string suitably weighted.

The weights of the portions are as follows :—

	lb.	oz.	dr.
1st portion (core)	0	6	5
2nd ,, ...	0	7	12
3rd ,, ...	0	13	3
Total	1	11	4

The bags of the 1st, 2nd and 3rd portions are coloured red, white and blue respectively. The 3rd portion is fitted with a lifting becket of braid.

The base of the case is stamped DRILL and is screwed and recessed to take a No. 1 drill percussion primer.

A leatherboard cup is inserted in the case and wedged against the charge, base downwards.

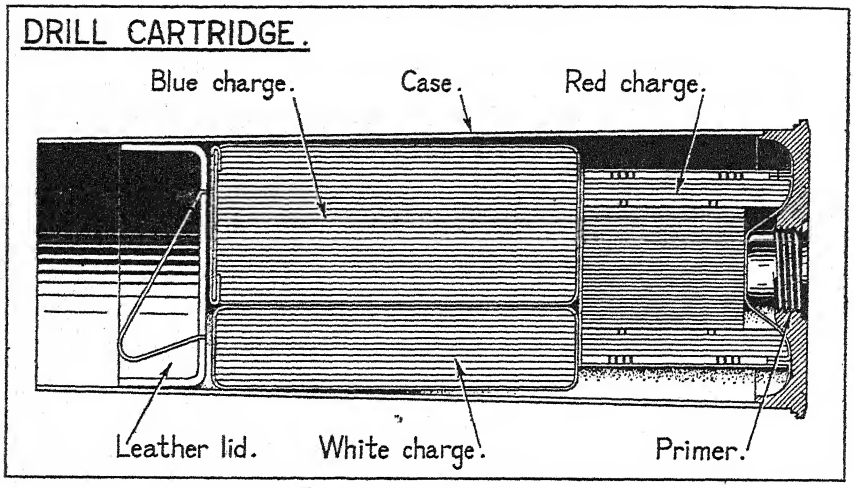


FIG. 91

The *Mark III* drill cartridge is similar to the *Mark I*, differing principally in being made up with the Mark II empty service case and in using coloured cotton cloth bags instead of coloured leather for the charge.

SHELL, DRILL, Q.F. 25-PR.

The *Mark I* drill shell consists of a hardwood body into which is fitted a steel central bolt with a lead weight cast on, a brass nose and base and a detachable steel cap.

The nose is screwed on to one end of the central bolt and secured to the body by a steel pin. The cap, with knurled band, screws on to the head.

The base is screwed on to the other end of the central bolt and secured by rivets.

The estimated weight without cap is 21 lb.

The *Mark II* drill shell differs from the *Mark I* principally in having a core of twelve lead weights which are held in position by a brass plug at the front and a hard rubber plug at the base. The plug is secured by a brass ring having two keyholes for fixing purposes.

Over the lead weights and between the brass nose and base, is vulcanized a rubber body.

The estimated weight without cap is 16 lb. 10 oz.

SHOT, DRILL, Q.F. 25-PR.

The *Mark I* drill shot is of cast iron, solid and covered in waterproof canvas, with the exception of the nose and base.

The base is stamped DRILL 25-PR. I, together with contractor's initials or recognized trade mark and date of manufacture (month and year).

The estimated weight, covered, is 15 lb. 7 oz.

DRILL FUZES

Fuzes for drill purposes are of the same external dimensions as the service fuzes.

On the exterior, metal portions are bronzed and steel portions are oil-blackened; however, certain fuzes will be found painted black all over, except the screw threads, to denote that they are to be used for DRILL PURPOSES ONLY.

Drill fuzes have the word DRILL stamped on them.

The No. 117 type is painted black all over on the exterior. This fuze may be of brass with no interior fittings, or, as an alternative, of metal made up of defective service components. With the latter type, a hole is bored through the centre of the bottom cap and magazine.

The No. 119 type is painted black all over except the screw threads, and a hole is drilled in the body to denote that it is for drill purposes only. It is provided with a knurled band around the body for distinguishing purposes.

The No. 221 type is blackened all over except the graduations and a patch which is left bright on the bottom time ring. The cap has four equi-spaced holes drilled through.

The polishing of drill fuzes is prohibited. The blackening and bronzing of drill fuzes is for the express purpose of distinguishing them from service fuzes.

AMMUNITION

The care, preservation and correct use of ammunition are matters of such great importance that instruction in the subjects must take high priority in the training programme of every artillery unit.

The accurate delivery of a suitable projectile, at a selected point, is the primary function of the gunner, but every effort to produce that effect will be entirely wasted if the primer or tube fails to fire or the fuze fails to function. It will therefore be obvious that attention to the care and maintenance of gun, carriage and other equipment, even when allied to great skill in gunnery, cannot possibly compensate for any neglect in the care and preservation of ammunition.

This care and attention can only be given satisfactorily by those who have been instructed in the design of various ammunition components and have a sound knowledge of their principles of action and are also well acquainted with the characteristics of the explosives in use.

Instructions regarding the care and storage of ammunition and explosives under

(*a*) Normal peace conditions, and

(*b*) Conditions whilst in the field

will be found, respectively, in Magazine Regulations and a small pamphlet entitled "Notes on the Care and Preservation of Ammunition and Explosives in the Field, Part I, Artillery Ammunition, 1941."

The following notes embody the more salient parts of the latter publication, and give details of the essential points to be observed in the care and maintenance of ammunition, particularly in war.

General

Every effort must be made to guard against the ill-effects of moisture and abnormal temperatures, and the necessity for constant vigilance in this respect cannot be stressed too strongly. This applies equally to exposed ammunition and ammunition still in original packages, all of which must be kept dry and protected from the direct rays of the sun, whether stacked or stowed in dumps or vehicles, or in transit.

In war it is necessary that a certain amount of ammunition should be kept ready for immediate use in close vicinity of the gun. Such "ready-use" ammunition may be in packages with loose lids or removed entirely from the packages and stored in vehicles or as may otherwise be found convenient. Whatever the method of storage adopted it is essential that such "ready-use" ammunition should be very carefully protected, otherwise it may deteriorate rapidly and prove to be of little use when required for the service of the gun. Such ammunition must therefore be kept to the absolute minimum, consistent with operational requirements.

Typical examples of the damage that may be expected as a result of exposure to the effects of moisture and abnormal temperatures are given hereafter and it will become evident that the maintenance of ammunition and explosives in a dry condition, at as even a temperature as is practicable, is a matter of vital importance.

Effects of moisture

Moisture has an adverse effect on most explosives, but more especially on gunpowder which is contained in fuzes, primers, tubes, igniters and cartridges, and which will be found, in one form or other, in practically every other kind of ammunition.

The presence of moisture may cause some types of detonator to become entirely inert and, in the case of other compositions and certain high explosives, it may cause chemical action which will result in the formation of dangerously sensitive compounds.

The combustion types of Time, and Time and Percussion fuzes are particularly susceptible to the ill-effects of moisture which, if it does not render them entirely unserviceable, will at least considerably vary their time of burning, according to the amount of moisture they have absorbed.

Dampness is likely to corrode the bodies of all fuzes, especially if made of aluminium, and, in addition, will rust or corrode the safety pins, when fitted to fuzes, thus making them difficult to withdraw.

Every effort is made in the design and manufacture of ammunition packages to protect the contents from the effects of moisture, and every ammunition component is designed and manufactured with a similar point in view. As a result, all ammunition is adequately protected against moisture when issued to the service, but the combined effort of designer and producer will be entirely defeated if, through lack of care on the part of units, the ammunition becomes affected by moisture and is thus rendered unreliable, unserviceable or dangerous.

Effects of temperature

Ammunition must be protected against the direct rays of the sun and must be maintained at as equable a temperature as possible.

In the case of certain propellants a high temperature, particularly one that exceeds 80 degree F., may lead to the exudation of mineral jelly and such exudation, if excessive, will deprive the propellant of its stabilizer. At low temperatures nitro-glycerine may be exuded and, if the low temperature condition persists for long periods, the loss of nitro-glycerine may be sufficient to seriously affect ballistics. Exposure to the direct rays of the sun, particularly in tropical countries, may cause a rapid increase in the rate of decomposition and so make the propellant unstable.

Hot, dry storage of certain detonators will render them entirely inert, whilst damp storage may cause the contents to decompose and interact with the metallic casing.

High explosives are little affected by low temperatures, but high temperature may result in the partial melting of the high explosive contained in shell.

High temperatures will reduce the normal moisture content of the powder contained in the time rings of certain fuzes, thus decreasing the time of burning, and it follows that alternate subjection to high and low temperatures will tend to give variable results with such fuzes.

Packages

Packages will be securely stacked in such a way as to ensure :—

(*a*) Protection against moisture.
(*b*) Free circulation of air.
(*c*) Ease of access.
(*d*) Visibility of all essential markings.

The stacks will be raised from the ground on battens and must not be in contact with outside walls.

Ammunition will always be stacked by lots, batches or dates as applicable. The reasons for stacking in this way are :—

(*a*) To ensure ease of identification should an unsatisfactory report be received on any particular lot.
(*b*) To enable inspection, test or proof to be fully representative of the lots in stock.
(*c*) To facilitate the tracing and withdrawal of lots and types which have either become over age or have been superseded by later Marks and types.

In normal circumstances the seals of ammunition packages are not to be broken until the contents are actually required.

In no circumstances is ammunition to be packed loose in packages that are not fitted with the proper partitions or internal containers, neither is it to be packed in unlabelled or incorrectly labelled packages. An accurate statement of the contents must always be securely affixed to packages containing live ammunition or explosives.

Ammunition packages, whether of steel, wood or other material, are designed to withstand the effects of the considerable rough usage that may normally be expected in transport and storage in the field. Nevertheless, the packages should invariably be treated with reasonable care and handled as carefully as possible, having regard to the circumstances prevailing at the time. The weight of each package rarely exceeds 1 cwt., which is a comfortable load for two men, and there is no reason why packages should be thrown about when they can be carried quite easily.

Unnecessary rough handling of ammunition packages may damage the contents and result in misfires, hangfires, blinds or even premature explosions. Unfortunately, the external appearance of a roughly-treated package may give no indication of the damage done to the contents, which may have been rendered wholly or partly unserviceable, and the person who eventually has to use the ammunition will have no knowledge of the treatment it has received and no means of deducing that it has been treated unfairly. Furthermore, packages so treated cannot be expected to remain airtight or watertight, so that the contents, even when they do not suffer directly at the time, may be expected to deteriorate rapidly and give most disappointing results, despite the great skill and care employed by designer and manufacturer. It follows that the necessity for the use of reasonable care in this respect is most essential and cannot be too strongly impressed on those whose duty it is to handle ammunition packages.

Any badly damaged packages should be set aside for technical examination, as also MUST all packages that have been dropped, whether damage is apparent or not.

Any unexpended ammunition components, whether service, practice or blank, are to be replaced in their original packages when firing has been completed. Such packages are to be suitably secured and legibly marked to indicate the contents.

Primers

Primers should be clean and the cap MUST be free from grit. If the cap is corroded, or corrosion is visible near to the cap, the primer should be removed and replaced.

They should be flush with, or very slightly below, the surface of the base of the cartridge case. They must never project beyond the base, and should any be found to do so an attempt should be made to screw them home, using the appropriate key for the purpose. Should it prove impossible to do this the primer is to be removed and replaced by another which should first be prepared by the application of thick luting under the flange and, thinly, on the screw threads, to ensure a watertight joint.

The primer must always be removed before any attempt is made to drive a jammed cartridge into the chamber by any operation which involves the hammering or tapping of the case.

When in action, an occasional fired cartridge should be inspected to see whether the primer has been struck centrally. Should the inspection reveal that the primer has not been so struck, the firing mechanism of the gun should be adjusted as found to be necessary.

Cartridges

Cartridges should be sorted and stacked according to the nature and size of the propellant.

Packages containing cartridges should be stacked clear of the ground and covered in such a manner as to protect them against rain and the direct rays of the sun and yet permit a free circulation of air.

The cartridge case should be free from dents, fluting and rust marks and must be kept clean and dry. Slightly dented cases may be used provided they gauge in the gun. Short cracks within an inch of the mouth of the case may be ignored, but a case cracked elsewhere is unserviceable and must not be used.

Oil is on no account to be applied to the case as it may adversely affect the primer or propellant charge and even render them unserviceable.

All cartridges are gauged before being packed for issue but, owing to possible divergencies in gun chambers and the possibility of mishaps to the ammunition in transport and storage, it is necessary that all " ready-use " cartridges should be gauged in the gun in which they are to be used. If a cartridge fails to gauge in one gun it should be tried in another of the same battery before it is rejected and set aside for return. The cartridge and chamber should be clean and dry ; the cartridge is to be inserted by hand, and should go fully home. The use for this purpose of any form of rammer, whether power or hand operated, is strictly forbidden and the breech must not be closed unless the striker has first been removed. Only " ready-use " ammunition should be treated in this way as it is most undesirable that ammunition packages should be opened unnecessarily. Whilst cartridges remain in their packages they are suitably supported and unlikely to be deformed, whereas those on improvised " ready-use " racks are liable to become distorted.

A cartridge must always be loaded strictly in accordance with the gun drill of the equipment concerned. If it jams before it is fully loaded into the chamber it should be withdrawn and, unless obviously damaged, tried in another gun. If difficulty is experienced in withdrawing the cartridge, and it cannot be forced home by using pressure or leverage on the breech mechanism lever, the primer must be removed before any attempt is made to drive the cartridge home by any operation involving the hammering or tapping of the case, either directly or indirectly. *A case must never be hammered or tapped, however gently, whilst the primer is still in position as there is a possibility that, although not struck, the primer may fire with disastrous results.*

Should the extractor levers fail to extract a cartridge case from the chamber the appropriate tool for removing jammed Q.F. cartridges should be employed in the manner described in Chapter IV. A cartridge unloaded by this means is not to be reloaded.

When possible, fired Q.F. cartridge cases are to be immersed for 15 hours in clean, and preferably warm, water containing half an ounce of soda crystals per gallon of water. They should then be scrubbed until clean, rinsed in clean water, dried thoroughly and afterwards coated, both inside and outside, with mineral jelly. The cartridge clips should then be replaced and the cases repacked in the packages in which they were supplied, the correct packing pieces being used for the purpose. Whenever convenient this procedure should be followed immediately firing has been completed.

Projectiles

Whenever possible boxed projectiles are to be kept in their packages until required for immediate use in the gun.

Unboxed projectiles should be stored with their bases on wooden battens, but when this is not possible, and they have to be piled, they will be arranged with the bottom tier on battens that are sufficiently thick to keep the driving bands clear of the ground. In order to further protect the driving bands each succeeding tier should be placed with heads of projectiles pointing in the same direction as the bases of those in the tier below and, when this cannot be done, thin battens must be placed between the tiers. The end projectiles in the bottom tier will be secured by wooden scotches fixed to the battens. The height of the pile will depend upon local conditions.

When a shell becomes jammed in the bore of a gun an application should be made for the services of an inspecting ordnance officer, who will supervise its removal.

Particular care must be taken to see that the points of A.P. projectiles are not broken or otherwise damaged and that the caps on capped projectiles are not loosened, cracked or dented.

All projectiles are to be kept clean, dry and free from dirt and grit.

The presence of grit might cause considerable damage to the bore of the gun in which the projectile is fired.

All projectiles are well painted when issued to units and every endeavour must be made to keep them so and preserve the coating of paint intact. It is very necessary that all markings on projectiles should remain easily discernible in order to facilitate identification. Projectiles will be repainted, when necessary, to prevent rust and obliteration of markings. Where damage to the paint has occurred, restoration of the protective coating by repainting should be confined to the damaged portions only, as additional paint over the existing coating may cause the shell to become " high to gauge." The repainting of projectiles will only be undertaken under the supervision of an inspecting ordnance officer. Special paints are required for the purpose in order to avoid dangerous interaction with the shell filling.

Units can effect temporary protection by the application of lead-free boiled linseed oil with a clean brush over those portions of the projectiles where the paint has been damaged. Any rust on the shell, where the paint has been damaged, should first be removed by the use of fine-grade emery cloth or a scratch card. The oil should be allowed to harden before the projectiles are re-stacked or repacked. Should the oil film be subsequently damaged it should be restored by a fresh coating of lead-free boiled linseed oil, applied as previously described.

The application of any oil, other than that referred to above, is strictly forbidden as it would probably have an ill-effect on the fuze, and, if it came into contact with the shell filling, might result in the formation of dangerous compounds.

The driving band is necessarily of soft metal and, in consequence, is easily damaged by careless handling. Rope grummets are provided on certain projectiles to protect the band and they should not be removed unnecessarily. It will usually be sufficient to remove the grummets from ready-use projectiles only. Projectiles with seriously damaged driving bands are not to be loaded into a gun as the damage may permit the escape of propellant gases past the band, thus causing irregular shooting, rapid erosion, and, possibly serious damage to the bore of the gun. Such projectiles should be set aside for special examination.

With certain shell containing high explosive an oily exudation may ooze out past the screw threads in the fuze hole, or by way of other exits. This is especially liable to happen where the condition of storage is moderately warm, and it is for this reason that some shell are marked to indicate that they are suitable for hot climates whilst the issue of others is confined to more temperate climates. Should signs of exudation be observed the affected shell should be set aside for technical examination.

Rubber drill shell should be smeared with french chalk before they are used in order to prevent " drag " in the bore of the gun.

The object of paper shot is to provide training in flash spotting and sound ranging and for proofing the gun and recoil system. It must not be used for recoiling the gun or for any purpose other than that for which it is intended, except on the authority, and under the supervision of, an E.M.E.

If time permits the bore should be cleaned out after each round.

Fuzes

As fuzes deteriorate rapidly when exposed to the atmosphere it is important that only such as are required for immediate use should be uncovered, or removed from their cylinders.

All openings in fuzes are coated with composition to prevent the entry of moisture and in normal circumstances, fuzes should remain waterproof.

Time, and time and percussion fuzes of the combustion type, are treated with waterproofing composition over the escape-hole discs in the time rings, in the set screw recess of the cap and also in the spaces between the cap, time rings and body. The threads of the base plug are treated with cement before the plug is inserted and afterwards the whole base of the fuze is covered with cement. These fuzes are further protected by metal or tinned-plate covers which form an integral part of the fuze and are secured in position by a soldered tear-off band or some similar means. They should be tested by pulling only.

When issued separately from shell all fuzes are packed in tinned-plate cylinders which are hermetically sealed by a tear-off strip which is soldered to the cylinder body and lid. In some cases the lids are secured to the body by tape and an adhesive.

From the foregoing it will be seen that the combustion types of fuzes of which the No. 221 may be considered a typical example, are adequately protected by waterproofing composition. The waterproof seal thus provided is sufficient to maintain the fuze in a serviceable condition so long as the seal remains unbroken. The seal is broken by any movement of the time ring, or by loss of tension, and unless it is restored immediately the fuze may rapidly become unserviceable. The ring is moved deliberately when the fuze is set and it may be moved accidentally by the turning of a loose fuze-cover or by vibration when travelling, acting on time rings that have become loose owing to loss of tension.

Whilst the fuze cover is in position on the shell it must be assumed that the fuze is serviceable, and usually the fuze will be found to be set at safety when the cover is removed.

Tensioning is the means by which the flame from the composition in the time rings is confined, and it also provides a seal against the entry of the flash of any propellant gases that may pass over the shell. Loss of tension may therefore lead to a "flash-over" or a premature. Further, if the time rings are loose they may move relative to one another and so alter the setting, thus leading to a blind, a burst out of the calculated position, or possibly a premature. Fuzes that have lost their tension or have loose rings must not, therefore, be used in a gun.

Loss of tension, with consequent movement of time rings, is a defect that is unlikely to be found frequently. Nevertheless, every effort should be made to detect such defects when fuzes are being uncovered. When a fuze is uncovered and found not to be at safety it is a clear indication that the fuze has probably lost its tension and, wherever possible, it should be removed and replaced by one that is known to be serviceable. Whether this can be done or not the fuze should be set at safety, the waterproof seal restored at once and the fuze set aside for technical examination.

Rubber covers and R.D.1154 will no longer be issued to Field Artillery regiments, therefore it is imperative that fuzes will not be set until immediately before firing. Should fuzes be pre-set for any special reason, the number must be kept to an absolute minimum and arrangements made that any such fuze not fired on that occasion will be fired at the next possible opportunity.

Thick luting may be used for waterproofing fuzes, but should only be used as a last resort on account of its tendency to harden and so jam the time rings. The use of thin luting for this purpose is forbidden.

Shellac is not to be used for the purpose of waterproofing fuzes.

A blind shell may be the result of a mechanical defect in the fuze, caused by rough handling during transit or whilst in store, or it may be due to faulty preparation for action, e.g. failure to withdraw the safety pin or remove the safety cap. Similar neglect or lack of care may also cause a premature explosion of the shell.

In time of war it is very necessary to guard against unauthorized tampering with ammunition, particularly fuzes. (During peace there are likely to be few opportunities for such a practice.) The offence is usually committed by individuals who desire to know the internal construction of the fuze concerned and are ignorant of the risks involved. It is obviously better to satisfy such curiosity by describing the fuze and its functions in detail, at the same time taking the opportunity to impress upon all concerned the dangers certain to arise as the result of unwarranted interference. A man who is aware of the risks attending the mishandling of explosives, who possesses a sound knowledge of the ammunition with which his unit is equipped and appreciates the necessity for its preservation in a serviceable condition, is less likely, than one who is ignorant of such details, to take liberties which will almost inevitably render the ammunition defective and unsafe and imperil himself, his comrades and his gun.

To fuze a shell

Only one shell is to be dealt with at a time by one person, and only the correct implements, described in Chapter IV, are to be used for the purpose.

The required fuze should be prepared as follows. Time, and time and percussion fuzes by lightly smearing the threads with thin luting and placing a fillet of the same on the shoulder below the washer. D.A. fuzes by lightly smearing the lower threads, except the innermost three, with thin luting and the upper threads with thick luting. A fillet of the latter is to be placed around the under side of the flange, if no washer is provided.

If a set screw is present in the shell it is to be loosened, after which the fuze-hole plug, and its washer, is to be removed and the prepared fuze inserted immediately. The fuze is to be screwed fully home, taking care that the fuze cover, when fitted, is not nipped between the fuze and the shell. (Some fuzes have a platform instead of a washer to ensure that this does not occur.)

Time, and time and percussion fuzes are usually retained in position by a set screw and this should be inserted when the fuze is fully home. The screw hole should first be filled with luting, any surplus being wiped off when the screw has been tightened.

The safety cap should be readily removable but is to be kept firmly screwed down on to its bearing washer and not removed from the fuze until the shell is required for loading.

Plugged shell are safer in transport and storage than those that are fuzed, and fuzes are best preserved when packed in their cylinders. For these reasons plugged shell should not, under normal conditions, be fuzed until they are required for use.

REMOVAL OF JAMMED SHELL OR SHOT FROM THE BORE OF THE GUN

A.—When the projectile is in the loaded position, i.e. has not taken the rifling.

B.—When the projectile has been forced to take the rifling by firing, but has not left the gun.

A.—The projectile will be ejected under the supervision of the gun position officer by using the ejector or by firing, as found most convenient.

By ejector.—Place a quantity of sacking or similar material in the chamber to act as a cushion and prevent damage to the projectile or breech mechanism, and close the breech. Lay the gun in a safe direction at a slight elevation and insert the ejector from the muzzle, taking care that the head fits snugly over the nose of the shell, clear of the fuze. The final adjustment of the ejector should be carried

out by one person, all others being behind the muzzle. Ropes, previously fitted to the stave of the ejector, are taken down on each side of the gun and manned equally by the detachment. The stress is then taken and the projectile forced to the rear. Should this fail, the ejector may be withdrawn about 1 to 3 inches by one person. The ropes are manned and a jerk given to them, which should move the projectile in most instances.

By firing.—Separate loading Q.F. guns can be cleared by loading a cartridge in the normal manner, laying the gun in a safe direction and firing. Fixed Q.F. guns can only be cleared in this manner by the use of a shortened cartridge case; the propellant charge and primer being taken from another cartridge.

B.—This is very unlikely to happen, but if it should the incident will be reported at once to the R.A.O.C. for the attention of the inspecting ordnance officer, who will make the necessary arrangements to clear the bore. In cases of extreme operational urgency, where technical supervision is not available, unit commanders may attempt removal of jammed shot or shell, the G.P.O. clearing the bore by firing. As there is a risk of premature, the operation *must* be conducted under precautions as follows :—

Lay the gun at maximum elevation and in a safe direction, load a propellant charge (maximum charge, to reduce as far as possible the risk of the round falling short) and arrange to fire by percussion, using a long lead (at least 15 yards). Place all personnel under cover and, when all is clear, fire from a covered position. The bore should then be inspected and, if damaged, the gun should be placed out of action for technical examination.

Salvage

Considerable economies will be effected by the efficient salvage of all used and unused ammunition components. Every care should therefore be taken to effect the recovery, in good condition, of empty cartridge cases with their clips, fuze-hole plugs with their washers, fuze covers and caps, grummets, and every kind of cylinder and package. The majority of such items can immediately be used again, with a considerable saving of time, labour and material. Others may need a certain amount of rectification, but even if they should prove to be entirely unfit for further service they will still be invaluable as scrap. They should therefore be evacuated from gun sites and battery positions as early as possible after the rounds, of which they form part, have been expended.

Empty ammunition packages must be handled with reasonable care in order that they may be used again. The lids, packing pieces, internal partitions, screws, nuts and everything else appertaining to them will be returned with the packages to which they belong. In order to avoid accidents the greatest care must be taken to ensure that such packages contain no ammunition, and are really free from all explosives before they leave the unit.

Unused portions of propellant charges which contain W cordite should be packed carefully in appropriate packages, which should be sealed and legibly marked to indicate the nature and quantity of the contents. These packages are not to be despatched with empty packages but must form a separate consignment.

Unused portions of charges containing M.D., M.C., and R.D.B. cordite will be destroyed locally under the supervision of the I.O.O.

Dangerous and forbidden practices

A case must never be hammered or tapped, however gently, whilst the primer is still in position, as there is a possibility that although not struck, the primer may fire, with disastrous results. Tampering with the mechanism of a fuze or primer is strictly forbidden.

Misfired primers and cartridges

Primers and cartridges which have been struck, but have not fired, are liable to be sensitive to shock, and accidents have taken place during normal handling, due to rounds containing misfired primers being included among serviceable ammunition.

Units will dispose of misfired rounds at the earliest opportune moment as follows :—

(*a*) If spare primers or cartridges are held the primer or cartridge will be changed.

(*b*) If spare primers or cartridges are not held, the misfired primer will be removed. The round will be plugged and set aside pending the insertion of a new primer.

(*c*) If, for any reason, it is impossible to remove a misfired primer or cartridge, the affected round will be set aside for destruction by the I.O.O. It will not, in any circumstances, be stored with or among serviceable ammunition.

Misfired primers or cartridges will be reported to the local I.O.O. who will arrange destruction.

In no circumstances will a round fitted with a misfired primer or cartridge be transported by road or rail, nor will it be mixed with unserviceable ammunition.

When returning ammunition to R.A.O.C. a certificate to the effect that there are no rounds fitted with misfired primers or cartridges in the consignment, will be rendered. Ordnance will not accept a consignment without this certificate.

CHAPTER VI

MARKINGS ON AMMUNITION AND PACKAGES

GENERAL REMARKS

Ammunition issued to the service is suitably marked to facilitate identification and to ensure correct segregation in store and transport. Markings also ensure that the correct types are used in the gun and assist greatly in tracing defects in design or manufacture, to their source.

Markings are of two kinds, permanent and temporary. The former are in the nature of stamping in the metal of the article concerned and relate, as a general rule, to the process of manufacture, whilst the latter are usually painted or stencilled, and refer more particularly to the explosive elements employed in the ammunition.

Great care should be exercised in the handling of ammunition, either loose or in packages, to avoid causing damage to the markings as partial obliteration may render it difficult and, in some cases, impossible to identify the article.

In drawing up a scheme of marking, the general principle observed is that it should always be possible to identify, from the information on the exterior, the contents of a package or a separate article and the conditions of manufacture.

PRIMERS

Stampings

(*a*) Number and Mark of primer.
(*b*) Manufacturer's initials or recognized trade mark.
(*c*) Date of manufacture (month and year).
(*d*) Monogram of filling station.
(*e*) Date of filling (month and year).
(*f*) Lot number.

After repair :—

(*g*) Contractor's initials or recognized trade mark with month and year.
(*h*) Letter M denoting repair and refilling.

Primers are issued assembled in the cartridge, in addition, spare primers are issued to replace misfires.

Stampings on the base

(*a*) Calibre of gun.
(*b*) Manufacturer's initials.
(*c*) Year of manufacture.
(*d*) Monogram and annealing series under number when the case has been low-temperature annealed.
(*e*) The letter C followed by an F for every time the case has been filled with a FULL charge.
(*f*) The letter C followed by an R for every time the case has been filled with a REDUCED charge.
(*g*) The letters F or R barred out, thus ~~F~~ or ~~R~~, for every time the case has been filled, but not fired with either full or reduced charge, respectively.
(*h*) Mark of empty case. (The letter S after the numeral denotes that the case has been repaired by rebushing the primer hole.)

Stencilling on the base of the case

A.P.	.. .. ..	Armour-piercing.
H.E.	.. .. ..	High explosive, full charge.
PRAC.	.. ..	Practice.
BX	.. .. ..	In conjunction with SMK denotes the presence of a smoke box, e.g. SMK. BX.
SMK.	.. .. ..	Smoke.
(T)	.. .. ..	Tracer is fitted.
PRAC. SPL.	.. ..	Special practice.

The above is stencilled with silver nitrate in $\frac{3}{4}$-inch type.

Stencilling on the side

(*a*) Lot number of the propellant.
(*b*) Nature and size of propellant, as applicable.
(*c*) Initials of firm filling or monogram of filling station.
(*d*) Date of filling (month and year).
(*e*) Mark of cartridge.
(*f*) The word FOIL if tinfoil or leadfoil has been included with the charge.
(*g*) The letters S.R. followed by the words PAPER SHOT when the contained charge is for use with paper shot only.

Markings on filled charge bags

(*a*) Lot number of the propellant.
(*b*) Nature and size of propellant, as applicable.
(*c*) Initials of firm, filling or monogram of filling station.
(*d*) Date of filling (month and year).
(*e*) Mark of cartridge.
(*f*) Calibre of gun.
(*g*) Weight of charge, as applicable.

Stampings on the base of cases containing blank charges

(*a*) BLANK.
(*b*) Calibre of gun.
(*c*) Mark of empty case.
(*d*) Lot number of case.
(*e*) Manufacturing or converting contractor's initials or trade mark.
(*f*) Year of manufacture or conversion.

NOTE.—On conversion of service pattern cases, for use with blank charges, all existing markings which are no longer applicable, will be barred out.

Stencilling on the side of cases containing blank charges

(*a*) BLANK.
(*b*) Mark of cartridge.
(*c*) Weight, size and lot of powder.
(*d*) Initials of filling firm or monogram of filling station.
(*e*) Date (month and year) of filling.

PROJECTILES

No markings are placed where the projectile surfaces touch the fittings of the box.

Stampings on the body

(*a*) Calibre and Mark.
(*b*) Manufacturer's initials or recognized trade mark.
(*c*) Date of completion of shell (month and year).
(*d*) The letters C.S., F.S., B.S. or S.S. denoting that the shell is made of cast steel, forged steel, bar steel or semi-steel respectively.
(*e*) Lot number of empty projectile.
(*f*) The letters C.I. denoting that the shell is made of cast-iron.

Painting

(*a*) High explosive shell are painted yellow.
(*b*) Smoke shell are painted green.
(*c*) Armour-piercing shot are painted black.
(*d*) Practice projectiles are painted black.

Stencilling

1. Tips of shell.

(*a*) Black tip denotes absence of smoke box in amatol-filled shell.
(*b*) White tip denotes armour-piercing shot.

2. Rings round the head.

(*a*) Red ring indicates that projectile is filled, wholly or partly with an explosive.
(*b*) A ring of red crosses in place of the red ring denotes that the shell is filled and suitable for hot climates.
(*c*) A black ring above the red ring indicates that the shell is fitted with exploders, only suitable for a powder-filled fuze.
(*d*) A white ring denotes armour-piercing shot.
(*e*) A ring of alternate crosses and bars in red denotes that the shell has a limited life in hot climates.

3. Bands round the body.

(*a*) Green band denotes shell filled amatol or T.N.T.
(*b*) Two black bands denotes H.E., practice projectile.
(*c*) One black band denotes empty H.E. shell to be used for drill purposes.
(*d*) Yellow band indicates practice projectile.

4. Additional markings.

(*a*) Calibre and Mark of shell.
(*b*) Design number of method of filling.
(*c*) Monogram of firm or filling station.
(*d*) Date of filling (month and year).
(*e*) T.N.T.-filled shell have T.N.T. stencilled on the green band.
(*f*) The fraction to indicate the proportion of amatol filling, e.g. 60/40, is stencilled below the green band.
(*g*) High explosive shell fitted with C.E. or T.N.T. exploders will be stencilled EXPR. C.E. or EXPR. T.N.T. respectively.
(*h*) Series number in a ring distinguishing filling lot.

(*i*) The abbreviation PHOS on smoke shell, denote the use of phosphorus as a smoke-producing mixture.
(*j*) Two white patches on shoulder of smoke shell diametrically opposite, with number of smoke composition stencilled on each.
(*k*) The letters B.E. on smoke shell denoting base ejection.
(*l*) Two green discs diametrically opposite each other on the head of H.E. shell denote the presence of a red phosphorus smoke box.

The letter A within the green discs denotes that a smoke box of aluminium is fitted and the letter B denotes one of bakelite.

(*m*) The symbol T in red on A.P. shot denotes a tracer is fitted.
(*n*) H.E. shell fitted with 119 fuze have the Mark of the fuze stencilled on them.

FUZES

Stampings

(*a*) Number and Mark of fuze.
(*b*) Contractor's initials or recognized trade mark.
(*c*) Date of manufacture (month and year).
(*d*) Initials of filling firm or monogram of filling station.
(*e*) Date of filling (month and year).
(*f*) Filled lot number. The letter Z after the number denotes that the fuze contains a detonator filled with lead azide.

Stencilling

(*a*) A large letter L denotes that the fuze weighs 2 lb. 2 oz. and over but does not reach 2 lb. 6 oz.
(*b*) The letters LL denote that the fuze weighs 1 lb. 14 oz. and over but does not reach 2 lb. 2 oz.

FUZE COVERS

Stampings

(*a*) Number and Mark of cover.
(*b*) Contractor's initials or recognized trade mark.
(*c*) Number and Mark of fuze.
(*d*) Initials of filling firm or monogram of filling station.
(*e*) Date of filling (month and year).
(*f*) Filled lot number. The letter Z after the number denotes that the fuze contains a detonator filled with lead azide.

AMMUNITION PACKAGES

CARTRIDGE BOXES

Q.F. 25-pr. cartridges are issued to the service in rectangular-shaped boxes, which are of steel and designed to contain 8 cartridges. The particulars of the box are shown in the following table :—

No. of box	Contents	Dimensions (inches)	Remarks
C.206, Mk. I	8 cartridges	19·0 × 9·7 × 12·1	
C.206, Mk. II	8 cartridges	19·0 × 9·7 × 12·1	Strengthened pattern lid.

Blank powder charges are issued to the service in metal-lined cases.

Markings, usually in the form of stencilling, are placed on the ends and sides of steel boxes where they are least likely to receive damage, and where they can be seen when piled or stacked.

Painting

Boxes are painted service colour.

Stencilling on both ends and both sides

(*a*) Mark of cartridge.
(*b*) Lot number of propellant, as applicable.

Stencilling on both sides

(*a*) Contents of box and calibre of gun, e.g. 8 CARTRIDGES, 25-PR.
(*b*) Monogram or initials of filling station.
(*c*) Date of filling (month and year).
(*d*) Sizes of propellant, as applicable.
(*e*) Weight of charge, as applicable.
(*f*) Nature of cordite, as applicable.

Stencilling on both ends

(*a*) Calibre of gun, e.g. 25-PR.
(*b*) Packing serial number of box.
(*c*) Initials or monogram of primer filler.
(*d*) Primer lot number.
(*e*) Date of filling primers (month and year).

PROJECTILE BOXES

Q.F. 25-pr. projectiles are issued to the service in rectangular-shaped boxes which are of steel and designed to contain 4 H.E. streamline, plugged or fuzed shell, in packing clamp, No. 1 ; or 4 smoke, B.E. plugged or fuzed shell, in packing clamp, No. 2.

The No. 1 clamp consists principally of a steel top and bottom diaphragm, spindle and a distance piece of gas tubing.

The No. 2 clamp is similar to the No. 1, differing principally in the omission of the spring, the top diaphragm being fitted with a steel locating plate, and in having a larger distance piece of steel.

The box designed to carry A.P. shot or practice is similar to the above, except that it is provided with No. 8 containers instead of clamps.

The container consists of a cylindrical paper body closed at one end by a lid with a tinned plate cap. It is shaped internally to suit the contour of the shot, and is painted service colour internally and externally.

The particulars of the boxes are shown in the following table :—

No. of box	Dimensions (inches)	Contents	Nature of Contents
P.59 (No. 1 clamp)	19·15 × 8·5 × 7·85	4 shell	H.E. shell.
P.59 (No. 2 clamp)	19·15 × 8·5 × 7·85	4 shell	Smoke shell.
P.60 (No. 8 containers) ..	19·37 × 12·3 × 5·2	4 shot	A.P. shot.
P.60 (No. 46 containers) ..	19·37 × 12·3 × 5·2	4 shot	Practice shot, Mk. IT or IIIT.

Painting

Boxes containing H.E. shell and A.P. shot are painted service colour, whilst those containing smoke shell are painted green.

Stencilling on both ends and both sides

(*a*) Contents of box, e.g. 4 SHELL.
(*b*) The abbreviation FZD when shell are fuzed.
(*c*) The word PLUGGED when shell are plugged.
(*d*) Number and Mark of fuze as applicable, when shell are fuzed.
(*e*) Green disc denoting H.E. shell with smoke composition in box.

Stencilling on both sides

(*a*) Contents of box, e.g. 4 SHELL.
(*b*) Nature of shell, e.g. SMOKE B.E. ; or H.E. as applicable.
(*c*) Calibre of gun, e.g. 25-PR.
(*d*) Design number of method of filling shell.
(*e*) Initials of firm or filling station.
(*f*) Date of filling (month and year).
(*g*) Initials of fuze filler and lot number of filled fuzes as applicable, when shell are fuzed.

Stencilling on both ends

(*a*) When smoke shell are packed the abbreviation SMK. B.E.
(*b*) When H.E. shell are packed, the letters T.N.T. if shell are filled T.N.T., or the fraction 60/40 or other fraction, denoting composition, if shell are filled amatol.
(*c*) Mark of shell as applicable.
(*d*) Red criss-cross, only on boxes containing shell which bear a similar marking round the nose, indicating suitability for use in hot climates.

LABELS

Labels as under will be found affixed to the boxes with shellac, those on the exterior to be coated with shellac afterwards.

(*i*) **Interior**

A packer's label affixed to the under side of lid, *viz.* Label No. 566A.

(*ii*) **Exterior**

(*a*) A Government explosive and classification label affixed to side of box.
Viz. : Cartridge box—Label No. L.1606 (Group VI).
Shell box—Label No. L.1611 (Group XI).
(*b*) Two station labels are affixed over junction of lid and body.

CHAPTER VII

POSITION OF STORES CARRIED ON VEHICLES

NOTE.—These lists are only amended periodically and are therefore not necessarily in agreement with the latest approved scales.

The contents of the ensuing lists are based on a 4-gun troop of two sections of four sub-sections.

MARK I CARRIAGE

Article	No.	Where carried
Adapter, pump, No. 4	2	In tool roll.
Apparatus, illuminating, sight, No. 5	1	Left rear of shield.
Axe, pick, 4½ lb.—		
Head	1	Right bracket of trail (outside).
Helve	1	Right bracket of trail (inside).
Box, spade	1	Across trail brackets.
Box, spare springs, keep pins, washers and insulators, No. 1	1	In spare parts box.
Box, spare parts; 25-pr. carriage	1	Right rear of shield.
Box, tool, 25-pr. carriage	1	On right of carriage, above axle.
Brush, breech screw	1	In tool box.
Can, lubricating, No. 11	1	On saddle.
Caps, sponge, No. 6	2	Right rear of shield.
Carrier, Nos. 7 to 7C dial sight, No. 18	1 (*a*)	On carriage.
Case—		
Field clinometer, No. 1	1	Right rear of shield.
Fuze key, No. 1	1	Left bracket of trail.
Nos. 7 to 7C dial sight	1	Right rear of shield.
Sighting telescope, No. 6	1	Left rear of shield.
Cleaner—		
Piasaba, No. 18	1	Right rear of shield.
Wool, No. 1	1	Right rear of shield.
Clinometer—		
Field	1 (*b*)	In case, right rear of shield.
Sight	1 (*a*)	In case, left rear of shield.
Covers—		
Breech	1	Across trail brackets when not in use.
Muzzle	1	
Carriage	1	
Sight	1	
Drifts—		
No. 1	1	In tool roll.
No. 2	1	In tool roll.
No. 18	1	In tool roll.
No. 27	1	In tool roll.
Funnel, filling, No. 16, Mark I	1	In stores tray.
Gauge, striker protrusion, No. 16	1	In spare parts box.
Hammers—		
Carpenters, claw, 1 lb. 8 oz.	1	In tool roll.
Lead, B.L. and Q.F. guns	1 (*b*)	In tool roll.
Handspikes, 25-pr. carriage	2	Outside right bracket of trail.
Implements, ammunition—		
Keys, No. 120	2	In case, left bracket of trail.
Keys—		
Cap square—		
No. 11	1	In tool roll.
No. 12	1	In tool roll.
M.V. corrector scale reader	1 (*c*)	In tool roll.
Removing jammed Q.F. cartridges, No. 1	1 (*b*)	In tool roll.
Lanyard, cocking, No. 4	1	In spare parts roll.
Ordnance, Q.F. 25-pr., Mk. II—		
Bush, firing hole, breech block (spare)	1	In spare parts box.

Article	No.	Where carried
Ordnance, Q.F. 25-pr., Mk. II—*contd.*		
Lever, control—		
Pin, retaining plunger .. .. ..(spare)	1	In spare parts box.
Spring .. ..(spare)	1	In spare parts box.
Pin, firing .. ..(spare)	1 (*b*)	In spare parts box.
Pins, keep, collar, actuating crank ..(spare)	2	In spare parts box.
Rollers, actuating crank .. .. ..(spare)	2	In spare parts box.
Springs—		
Buffer, breech block .. .. ..(spare)	1 (*a*)	In spare parts box.
Main, percussion striker .. .. ..(spare)	1 (*a*)	In spare parts roll.
Plunger, breech mechanism lever ..(spare)	1 (*a*)	In spare parts roll.
Retaining catch plunger, striker cae ..(spare)	1 (*a*)	In spare parts box.
Safety catch plunger, striker case ..(spare)	1 (*a*)	In spare parts box.
Trigger sear, striker case .. .. ..(spare)	1 (*a*)	In spare parts box.
Sear, trigger, striker case .. .. ..(spare)	1 (*a*)	In spare parts roll.
Staple, retaining, firing pin .. .. ..(spare)	1	In spare parts roll.
Packing, asbestos, square, $\frac{5}{16}$-in., 40 ins. long (lengths)	1	In spare parts roll.
Pad, knee, 25-pr. carriage	1	On left bracket of trail.
Pins, keep, split—		
$\frac{1}{16}$ in. × $\frac{3}{4}$ in.	4	In spare parts box.
$\frac{3}{32}$ in. × $1\frac{1}{2}$ in.	6	In spare parts box.
$\frac{1}{8}$ in. × $1\frac{1}{2}$ in.	4	In spare parts box.
$\frac{5}{32}$ in. × $2\frac{1}{4}$ in.	4	In spare parts box.
Platform, firing, No. 9	1	Under trail brackets.
Pliers, flat nose .. .. (prs.)	1	In tool roll.
Posts, aiming, crosshead, No. 1—		
Circular head	2 (*e*)	On front of shield.
Square head	2 (*f*)	On front of shield.
Rammer, Q.F. 25-pr., No. 1	1 (*d*)	Inside right trail bracket.
Rammer, Q.F. 25-pr., No. 2	1 (*d*)	Inside right trail bracket.
Rolls—		
Spare parts	1	In spare parts box.
Tool	1	In tool box.
Ropes, drag, No. 1	2	On front of shield.
Screwdrivers—		
Cabinet, 4 in.	3 (*b*)	In tool roll.
$2\frac{1}{2}$ in.	1	In tool roll.
Shovel, G.S.	1	On front of shield.
Sight, dial, No. 7 to 7C, 9 or 10	1	In case, right rear of shield.
Spanners, adjustable—		
11 in.	1 (*b*)	In tool roll.
15 in.	1	In tool roll.
Spanners—		
No. 244	1	In tool roll.
No. 781	1	In tool roll.
No. 782	1	In tool roll.
Stop, running back	1	On rear of cradle.
Telescope, sighting, No. 29	1	In case, left rear of shield.
Tool, artillery, No. 201	1	In tool roll.
Wrench, breech mechanism, No. 247	1	In spare parts roll.

(*a*) One additional allowed to each troop.
(*b*) Each section.
(*c*) Two additional allowed each battery.
(*d*) One additional allowed each section.
(*e*) A and C sub-sections.
(*f*) B and D sub-sections.

NO. 27 ARTILLERY TRAILER

(Plate 5.)

NOTE.—Trailers are interchangeable with regard to the carriage of stores.

Article	Carr. trailer	Section ammunition trailer		Where carried
		Front	Rear	
Apparatus, illuminating, aiming point, with post and spring	1	—	—	In stores tray
Axe, felling	1	1	—	In stores tray
Axe, pick, 4½ lb.—				
Head	1	1	—	In stores tray
Helve	1	1	—	In stores tray
Boxes—				
Charging pumps	—	—	1 (*a*)	In stores tray
Hydro-pneumatic packings, No. 1	1	—	—	In stores box
Lamp, siege, to hold 2	1	—	—	In stores tray
No. 1 percussion primers	1	—	—	In stores box
Packing, washers, No. 3	1	—	—	In stores box
Spare springs, keep pins, washers and insulators, No. 1	1	—	—	In stores box
Store, 25-pr. Mark I carr.	1	—	—	In stores tray
Brace, wheel nut, for ½ in. Whit., light pattern	1	—	—	In stores box
Brush—				
Water carriage	1	1	—	As convenient
Wire, wheels, to Spec. M.C.86A	1	—	—	In locker, ammn. box
Bubble, spirit, glass, L. (spare)	1	—	—	In stores box
Buckets, water, canvas	2	1	—	In locker, ammn. box
Cans, lubricating, No. 3	2	—	—	In stores box
Carriage, 25-pr., Mark I—				
Springs, plunger, firing gear (spare)	1 (*a*)	—	—	In stores box
Carriers, ammunition, Q.F. 25-pr.	1	2	2	In stores tray
Cartridges, Q.F. 25-pr., filled	32	32	32	In ammn. box
Covers, apparatus, illuminating, aiming point (sets)	1	—	—	In stores tray
Crowbar, 4 ft. 1 in.	1	1	—	In stores tray
Ejector, projectile, Q.F. 25-pr.	—	—	1 (*b*)	In stores tray
Files—				
Second cut, half-round, 6 in.	1	—	—	In stores box
Smooth, flat, 6 in.	1	—	—	In stores box
Smooth, hand, safe edge, 8 in.	1	—	—	In stores box
Handle, small	1	—	—	In stores box
Gauge, tyre, low pressure, max. 50 lb. per sq. in., in cylindrical wooden box with screw lid	1	—	—	In stores box
Handspikes, 25-pr. carriage	1	1	—	In stores tray
Hook, bill	1	1	—	In stores tray
Hub, wheel, anti-friction, detachable, No. 24	—	—	1 (*a*)	On top of ammn. box offside
Injector, lubricating, Tecalemit, type T.26	1	—	—	In stores box
Implements, ammunition—				
Holder, cartridge, Q.F. 25-pr.	1 (*a*)	—	—	In stores box
Keys—				
No. 34, primers, 25-pr.	1 (*a*)	—	—	In stores box
No. 119, inserting or removing Nos. 220 and 221 fuzes	2	—	—	In stores box
No. 120, setting Nos. 220 and 221 fuzes	2	—	—	In stores box
No. 121, 2 in. percussion fuzes	1	—	—	In stores box
Pins, plain	4 (*c*)	—	—	In stores box
Jack, lifting, screw, 2½ tons	1 (*a*)	—	—	In stores tray
Handle	1 (*a*)	—	—	In stores tray
Lamps, siege	2	—	—	In box, in stores tray

Article	Carr. trailer	Section ammunition trailer		Where carried
		Front	Rear	
Line, natural, hambro'	1	1	1	In locker, ammn. box
Pump, tyre, foot operated, multi-stage, without pressure gauge	1	—	—	In stores box
Ropes, drag, No. 1	2	1	—	In stores tray
Saws—				
Folding (in case)	1	—	—	In stores box
Hand, 26 in.	1	—	—	In stores box
Screws, adjusting, dial sight	2 (c)	—	—	In stores box
Screws, fixing, fuze, B .. .. ..(spare)	2 (c)	—	—	In stores box
Screwdrivers, cabinet, 4 in.	1	—	—	In stores box
Shells, Q.F. 25-pr.	32	32	32	In ammn. box
Shovel, G.S.	1	1	—	In stores tray
Spade, Mark III..	1	1	—	In stores tray
Spring, catch, No. 8 towing attachment hook	1	—	—	In stores box
Spring, clinometer	1 (f)	—	—	In stores box
Trailer, artillery, No. 27—				
Springs, pawl, brake operating gear (spare)	1	—	—	In stores box
Trays, ammunition, No. 4	16	16	16	In ammn. box
Washers, copper—				
$\frac{3}{4}$ in.; $\frac{5}{8}$ in.; 0·07 in. thick ..(spare)	1 (e)	—	—	In stores box
Washers, fibre—				
$\frac{1}{16}$ in.; $\frac{1}{2}$ in.; $\frac{1}{16}$ in. thick .. ..(spare)	1 (e)	—	—	In stores box
$\frac{5}{16}$ in.; $\frac{11}{16}$ in.; $\frac{1}{16}$ in. thick.. ..(spare)	1 (e)	—	—	In stores box
$\frac{7}{16}$ in.; 0·53 in.; $\frac{1}{16}$ in. thick ..(spare)	1 (e)	—	—	In stores box
$\frac{9}{16}$ in.; $\frac{5}{8}$ in.; $\frac{1}{16}$ in. thick .. ..(spare)	1 (e)	—	—	In stores box
1 in.; $\frac{3}{4}$ in.; $\frac{1}{16}$ in. thick .. ..(spare)	1 (e)	—	—	In stores box
2·52 in.; $2\frac{1}{8}$ in.; 0·08 in. thick ..(spare)	1 (d)	—	—	In stores box
$3\frac{5}{16}$ in.; $3\frac{1}{16}$ in.; $\frac{1}{8}$ in. thick ..(spare)	1 (d)	—	—	In stores box
Wrench, adjusting, Nos. 7 to 7C dial sight and carriers	1 (a)	—	—	In stores box

(a) Each section.
(b) Each troop.
(c) Carried in Box, spare springs, keep pins, washers and insulators, No. 1.
(d) Carried in Box, packing washers, No. 3.
(e) Carried in Box, hydro-pneumatic packings, No. 1.
(f) According to Mark of clinometer in use.

LIST OF STRAPPING
MARK I CARRIAGE

Designation	No.	Stores for which used	Where carried
Straps, securing—			
1 in. × 48 in.	2	Covers, various.	Across brackets of trail.
1 in. × 40 in.	2	Tool case.	Right bracket of trail.
1 in. × 34 in.	2	Spare parts case.	Right rear of shield.
1 in. × 26 in.	1	Handspikes.	Right bracket of trail.
1 in. × 26 in.	1	Manhandling ropes.	Front of shield.
1 in. × 12 in. Q.R.	1	Manhandling ropes.	Front of shield.
1 in. × 10 in.	1	Pick axe helve.	Right bracket of trail.
1 in. × 8 in.	1	Pick axe helve.	Right bracket of trail.
1 in. × 8 in.	2	Rammer.	Right bracket of trail.
1 in. × 8 in.	2	Shovel.	Front of shield.
1 in. × 6 in.	1	Pick axe.	Front bracket of trail.
$\frac{3}{4}$ in. × 22 in.	1	Field clinometer.	Right rear of shield.
Buckling pieces—			
Left	1	Dial sight case.	Right rear of shield.
Right	1	Dial sight case.	Right rear of shield.

NO. 27 ARTILLERY TRAILERS

Designation	Carr. trailer	Section ammunition trailer		Store for which used	Where carried
		Front	Rear		
Straps, securing—					
1 in. × 60 in. D.L.	—	—	2	Charging pump box and ammunition carriers.	Stores tray.
1 in. × 50 in. D.L.	1	—	—	Siege lamp box, aiming point illuminating apparatus and ammunition carriers.	Stores tray.
1 in. × 47 in. D.L.	2	—	—	Store box, spade and shovel.	Stores tray.
1 in. × 40 in. D.L.	—	1	—	Pick axe, helve crowbar, shovel, spade, handspike and ammunition carriers.	Stores tray.
1 in. × 38 in. D.L.	—	1	—		Stores tray.
1 in. × 36 in. D.L.	—	1	—	Post of aiming point illuminating apparatus, handspike and crowbar.	Stores tray.
1 in. × 30 in. D.L.	1	—	—	Pick axe, felling axe and jack handle.	Stores tray.
1 in. × 28 in. D.L.	—	—	1	Projectile ejector.	Stores tray.
1 in. × 26 in. D.L.	1	—	—	Lifting jack.	Stores tray.
1 in. × 24 in. D.L.	—	1	—	Felling axe.	Stores tray.
1 in. × 20 in. D.L.	—	—	1	Projectile ejector.	Stores tray.
1 in. × 10 in. D.L.	1	1	—	Bill hook.	Stores tray.

NO. 27 ARTILLERY TRAILER

Packing diagram.

In Locker

1 brush, wire, wheels
1 line, natural, hambro'

On top
1 hub, wheel, detachable

16 cartridges	16 cartridges
16 shell	16 shell
8 trays ammn.	8 trays ammn.

On Stores Tray

1 app. illuminating, aiming point with post, spring and cover.
1 axe, felling.
1 axe, pick, 4½ lb.
1 box, charging pump.
1 box, lamp, siege, with lamps.
1 carrier, ammunition.
1 hook, bill.
1 box, store.
1 crowbar, 4 ft. 1 in.
1 ejector, projectile.
1 handspike, 25-pr. carriage.
1 jack, lifting, screw, 2½ tons with handle.
1 shovel, G.S.
1 spade.
2 ropes, drag, No. 1.

MARK I CARRIAGE

1 axe, pick head.

2 handspikes, 25-pr. carr.
1 rammer, Q.F. 25-pr.
1 axe, pick, helve.
1 box, tool, 25-pr.

1 box, spade.
1 can, oil, No. 11 (on saddle).

1 platform, firing.
1 cover, overall.
1 cover, breech.
1 cover, muzzle.
1 cover, sight.
1 stop, running back (on cradle).

1 pad, knee, 25-pr.
1 case, fuze key, No. 1.
2 implements, ammn., keys, No. 120.

In front

2 ropes, drag, No. 1.
1 shovel, G.S.
2 posts, aiming, crosshead, No. 1.

In rear

1 clinometer, sight *in case*.
1 case, sighting telescope, No. 6.
1 telescope, sighting, No. 29.
1 apparatus, illuminating, sights.
1 clinometer, field, *in case*.
1 sights, dial No. 7 to 7C, *in case*.
1 box, spare parts.
1 cleaner, piasaba, No. 18.
1 cleaner, wool, No. 1.
2 caps, sponge, No. 6.

Contents of stores box

Boxes—
Hydro-pneumatic packings, No. 1 1
No. 1 percussion primers 1
Packing washers, No. 3 .. 1
Spare springs, keep pins, washers and insulators, No. 1 1
Brace, wheel nut, for ½ in. Whit., light pattern .. 1
Bubble, spirit, glass, L .. 1
Cans, lubricating, No. 3 .. 2
Files—
Second cut, half-round, 6 in. 1
Smooth, flat, 6 in. .. 1
Smooth, H.S.E. 8 in. .. 1
Handle, small 1
Gauge, tyre, low pressure, max. 50 lb. per sq. in., in cylindrical wooden box with screw lid .. 1
Injector, lubricating, Tecalemit, type T.26 .. 1
Implements, ammn.—
Holder, cartridge .. 1
Keys—
No. 34 1
No. 119 2
No. 120 2
No. 121 1
Pins, plain 4
Pump, tyre, foot operated, multi-stage, without pressure gauge .. 1
Saw, folding (in case) .. 1
Saw, hand, 26 in. 1
Screws, adjusting, dial sight .. 2
Screws, fixing, fuze, B .. 2
Screwdrivers, cabinet, 4 in. .. 1
Springs, catch, No. 8 towing attachment hook 1
Washers, copper—
$\frac{3}{4}$ in.; $\frac{5}{8}$ in.; 0·07 in. thick .. 1
Washers, fibre—
$\frac{1}{10}$ in.; $\frac{1}{2}$ in.; $\frac{1}{10}$ in. thick .. 1
$\frac{6}{10}$ in.; $\frac{6}{10}$ in.; $\frac{1}{10}$ in. thick 1
$\frac{8}{10}$ in.; 0·53 in.; $\frac{1}{10}$ in. thick 1
$\frac{1}{10}$ in.; $\frac{5}{8}$ in.; $\frac{1}{10}$ in. thick .. 1
1 in.; $\frac{3}{4}$ in.; $\frac{1}{10}$ in. thick .. 1
2·52 in.; $2\frac{1}{4}$ in.; 0·08 in. thick 1
$3\frac{6}{10}$ in.; $3\frac{1}{10}$ in.; $\frac{1}{8}$ in. thick 1

CHAPTER VIII

CARE AND PRESERVATION

Personnel responsible for carrying out care and preservation of Artillery equipments and connected stores, must be given every facility to acquaint themselves with the instructions contained in this Chapter. The efficient observance and application of these instructions will not only ensure a high standard of serviceability but will also minimize the possibility of damage to equipment or injury to personnel when carrying out certain operations connected with hydro-pneumatic or spring recuperators. Strict adherence to the following instructions is therefore essential.

LUBRICATION

Artillery equipments have a number of moving parts liable to damage by dirt or rust; cleaning and oiling are therefore necessary to preserve equipments.

Thorough and frequent lubrication of all working parts is essential. Whenever or wherever fresh lubricant is applied, the old should, where practicable, first be wiped or scraped off and the parts well worked to distribute the fresh lubricant.

Lubricators and lubricating holes should be kept free from dirt to allow a free passage to the working parts, holes and channels, where possible, being cleaned out with wire. Lost or damaged lubricators and lubricating hole screws will be renewed. Lubricators and lubricating-hole screws should be kept bright so as to be readily seen.

In cleaning the parts of the mechanism and the bright parts of carriages, etc., oil only should be used, and no part is to be burnished or polished with any gritty substance, such as emery cloth or bath-brick.

All spare parts should be tested for interchangeability as soon as possible after receipt.

LUBRICANTS

NOTE.—The normal range of ambient (surrounding) temperatures, in degrees Fahrenheit, for various climatic conditions are :—

Normal, 110 to 40. **Cold,** 40 to zero. **Sub-cold,** zero to minus 60.

Grease, G.S.

To reduce wear on towing eyes and hooks, and in wheel hubs fitted with ball and roller bearings. Must be diluted with 15 per cent. (by weight) kerosene, burning, in cold or sub-cold climates. In very cold conditions W.D. grease A will be used. If not available diluted G.S. grease will be used, as stated.

Grease, graphited

For external screw threads on gun and screw threads of the recoil system, etc. To be diluted with kerosene, burning, in cold or sub-cold climates.

Mineral jelly

As a preservative generally. Should be warmed to facilitate application in cold or sub-cold climates.

Mineral, jelly, thinned with C.70 oil

Enclosed gears where pressure lubrication is not used, nor any other lubricant specified. Must be diluted with kerosene, burning, in cold or sub-cold climates.

Oil, graphited concentrate

Gun slides or cradle guides having top oiler lubricators, or where an oil-can can be applied direct. Must be diluted with kerosene, burning, in cold or sub-cold climates.

Oil, C.600 or M.800 with 10 per cent. oil, graphited, concentrate

Gun slides or cradle guides having Tecalemit nipples. C.600 must be diluted with kerosene, burning, in cold or sub-cold climates, M.800 not being used.

Oil, kerosene, burning

Cleaning clogged oil off gears, and for use in diluting other lubricants for use in cold or sub-cold climates.

Oil, C.600 or M.800

For forced feed lubrication and gear boxes. C.600 must be diluted with kerosene, burning, in cold climates, M.800 not being used.

Oil, M.65

For forced feed lubrication and gear boxes in sub-cold climates. Must be diluted with kerosene, burning, in temperatures below minus 30 degrees Fahrenheit.

Oil, C.70

Cleaning bright parts of guns and carriages, and for general purpose of lubrication. In cold climates " A " oil will be used. This oil will be diluted with kerosene, burning, for temperatures below 20 degrees Fahrenheit.

Oil, low-cold-test, No. 2

Cleaning bright parts of guns and carriages, and for general purposes of lubrication in cold and sub-cold climates. Must be diluted with 20 per cent. kerosene, burning, in temperatures below minus 40 degrees Fahrenheit.

Oil, Acheson's E.P./L.

For breech mechanisms. Must be diluted with kerosene, burning, in cold or sub-cold climates.

NOTES.—It should be understood that the ambient temperature does not necessarily define the temperature or working condition of the gear or parts to be serviced. The equipment, or parts of it, may be at quite different temperatures from that of the air.

Where kerosene is to be used as a diluent, the lower the range of temperature, the greater the proportion of kerosene necessary. Normally the proportion should not exceed 25 per cent.

LIST OF LUBRICATORS AND LUBRICATING HOLES

PROVISIONAL

(Plate 6)

Position of lubricator	No. of lubricators	Reference No. on chart
GUN		
Shaft, actuating	2	1, 2
CARRIAGE		
Hubs—		
Plates, cover, brake drum	2	3, 4
Plugs, oil	2	5, 6
Trail—		
Bracket, trail eye	2	7, 8
Catch, locking, handspike	3	9 to 11
Pins, axis, stay catch lever	2	12, 13
Pin, hinge, cradle clamp	1	14
Traversing gear—		
Pivot bearing	1	15
Shield—		
Pin, axis, sight port cover	1	16
Clamp, cradle—		
Catch, retaining, plunger	1	17
Pin, pawl, retaining catch	1	18
Plunger, locking	1	19
Gear, operating, brake—		
Brackets, carrying shaft	2	20, 21
Saddle—		
Bracket, supporting, sight	1	22
Cap squares	2	23, 24
Pin, connecting, traversing gear	1	25
Pinion, arc	1	26
Pivot	1	27
Shafts, elevating worm	3	28 to 30
Sight—		
Arm, operating sight	1	31
Bearing, spindle, driving worm	1	32
Bracket, supporting, sight	1	33
Block, adjusting	1	34
Link, quadrant	2	35, 36
Pin, hinge, cross-levelling	1	37
Cradle—		
Guides—		
Upper	6	38 to 43
Lower	6	44 to 49
Segment—		
Bevel pinion	1	50
Bevel wheel	1	51
Gear, firing—		
Pin, axis, firing lever	1	52
Plunger, firing	1	53

NO. 27 ARTILLERY TRAILER

(Fig. 92)

Position of lubricator	No. of lubricators	Reference No. on chart
Gear, operating, brake—		
Brackets, cross-shaft—		
Centre	1	1
Off	1	2
Near	1	3
Bracket, securing, lubricating tubes	1	4
Lever, hand	1	5
Perch—		
Bracket, securing, grease tube	2	6, 7
Drawbar—		
Sleeve, plunger limiting rotation	1	8
Pin, buffer spring	1	9
Hook, towing attachment, No. 8	1	10
Hub, wheel, anti-friction, detachable Nos. 2 and 24—		
Plates, cover, brake drum	2	11, 12
Plugs, oil	2	13, 14

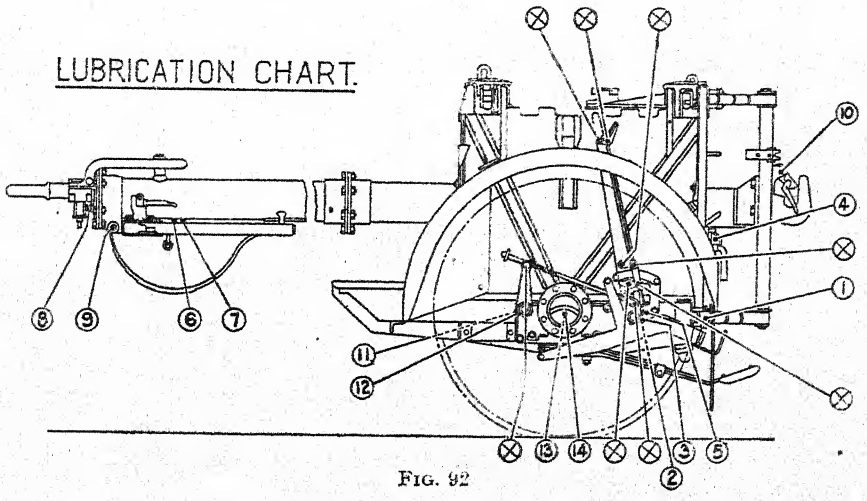


FIG. 92

Points indicated thus ⊗ are to be lubricated by No. 11 lubricating can.

SPEED LIMITS

The speed of vehicles will be referred to as :—

1. Speed—this being the average speed over a route including the time spent during halts, and is expressed as miles in the hour (m.i.h.).

2. Cruising speed—this being the speed indicated on an accurate speedometer over open section of the road to maintain the average speed in 1, and is expressed as miles per hour (m.p.h.).

To avoid damage to equipments of mechanized units, when travelling on good roads, the authorized maximum speed shown hereunder must on no account be exceeded.

Field carriages and trailers fitted with pneumatic-tyred wheels—

Maximum cruising speed (m.p.h.) 25

Speed on indifferent roads or across country will be at the discretion of the officer, warrant officer, or N.C.O. conducting the column, but must not exceed the above-mentioned road limits.

TO CRATE FOR TRANSPORTATION

1. The object of this procedure is to enable units to crate their own equipments for transportation by land or sea, using only unit facilities and personnel. The crates are provided from ordnance supply and are of standard size with each part numbered.

2. Number of men required for each equipment is a minimum of 8; 10 men if available.

3. **Tools required for stripping and assembling:—**

Drifts, brass		1
Hammers		1
Handspikes, lifting 6-feet or 7-feet		3
Pliers, sidecutting	pairs	1
Salvagees or rope slings		2
Spanners—		
Adjustable, 11-inch		1
Adjustable, 15-inch		1
Double-ended, $\frac{3}{8}$-inch × $\frac{7}{16}$-inch		2
Double-ended, $\frac{1}{2}$-inch × $\frac{9}{16}$-inch		1
Double-ended, $\frac{5}{8}$-inch × $\frac{11}{16}$-inch		2
Screwdrivers, 9-inch		1
Wheel brace		1

These spanners form part of the contents of "Chests tool filled," FITTERS, M./T., R.A. and R.A.C.

4. **Lifting tackle required:—**

If an L.A.D. with a 3-ton breakdown lorry is available, the crane can be used for lifting and positioning the gun and cradle as one body.

If no breakdown lorry is available the gun and cradle must be handled as separate loads.

5. Two crates are required, one termed Crate, main, 25-pr., Mark I, to contain the complete equipment, less shield and firing platform, and includes a box for the sight gear and various small gears as shown below. The box is bolted to two wood bearers, which in turn are bolted to the two outer bearers of the crate.

The second crate, termed Crate, Shield and firing platform, 25-pr., Mark I, as the name implies, carries the shield and firing platform.

6. **Contents of Box, sight, gear**

Part No.	Ordnance, Q.F., 25-pr., Mark II—	No.
	Body—	
	Brake, recoil, muzzle—	
FL 5484	Brake	1
	Breech mechanism—	
FL 67A	Case, striker, A	1
	or	
FL 221A	Case, striker, B	1
	Block, breech, A—	
FL 2415	Bracket, intermediate cocking lever	1
	or	
	Block, breech, B—	
FL 3871	Bracket, intermediate cocking lever	1
FL 72A	Lever, cocking, intermediate	1

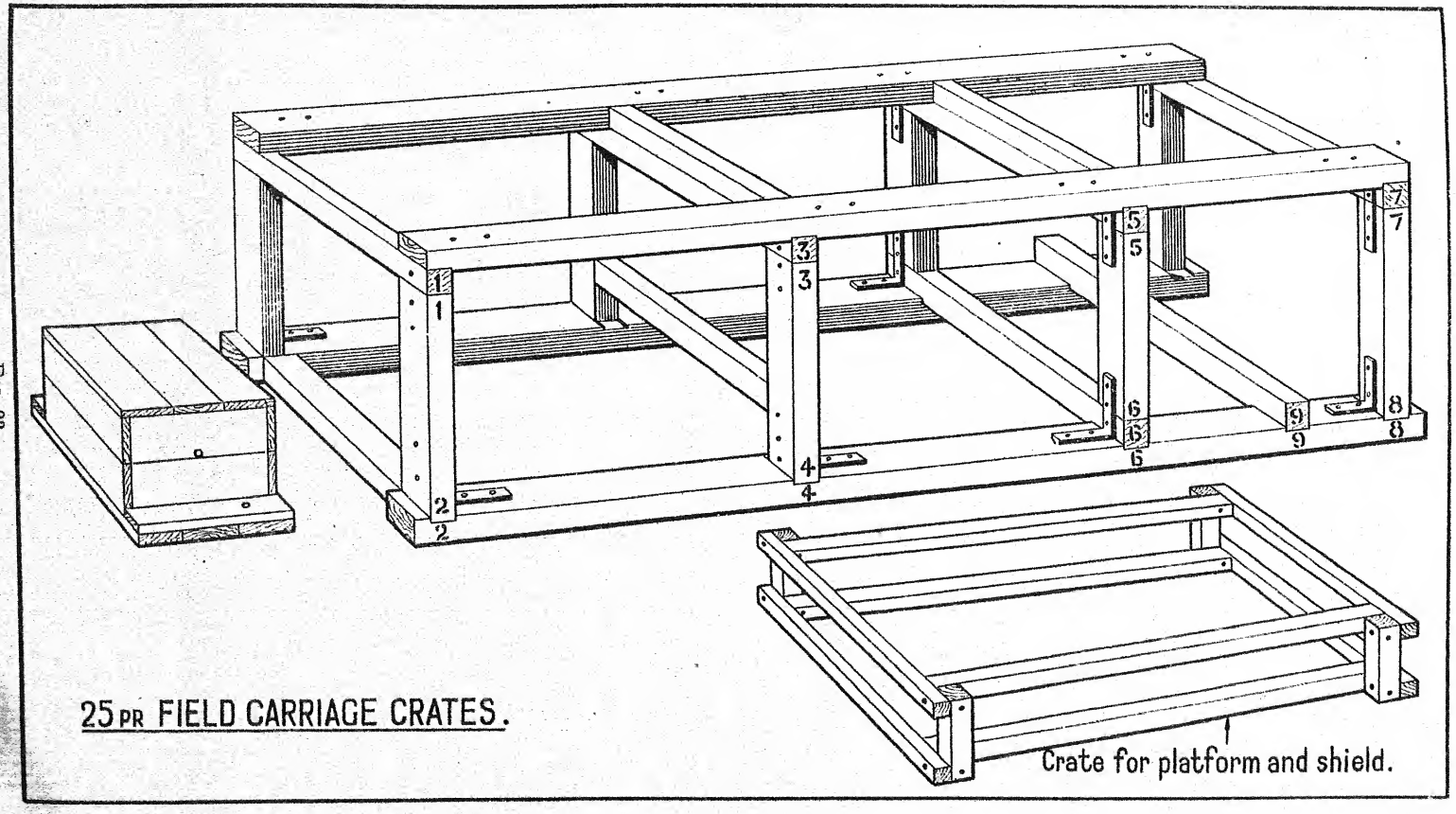


FIG. 93

(*u*) Pass the short steel rod provided through cross piece 3/15; over the ends of the rod fit the shield stay brackets and four 4½-lb. pick heads, one stay and two pick heads on each side of the cross piece.

(*v*) Pass tie rods through cross pieces Nos. 5/13 and 6/14, fitting steel packing plates to the ends of the rods and tightening securely.

(*w*) Wrap parallelscope and stands in the gun overall cover, lash together and place the parcel so made outside the rake-shaped packing piece for the wheel hubs.

Place in position, on the outside of the crate, the two screwed wood retaining battens. These should fit snugly against the parallelscope parcel.

(*x*) Cut-off gear actuating rod, aiming posts, shovels and pick helves are bundled together and lashed to the axle.

(*y*) The sighting gear box should now be packed with the stores detailed in page 250.

(*z*) The spare parts box is strapped on top of the tool box, which travels in its normal position on the trail. No. 11 oil cans and the two handspikes also travel in their normal positions.

NOTE.—Great care should be taken to replace all nuts, bolts, split pins, spring and tab washers in their correct positions wherever possible, to avoid loss and damage due to incorrect assembly.

9. To crate—platform and shield

(*a*) The crate for platform and shield consists of two rectangular frames fitting one above the other with a distance piece at each corner. The lower frame is slotted to receive projections on shield and platform.

(*b*) The brackets spare parts box and brackets securing No. 7 dial sight case are removed from the shield and secured by screws to the lower frame.

(*c*) The shield is placed in position on the lower frame and on top of the shield the platform is fitted.

(*d*) The upper frame is now placed on top of the platform and the corner distance pieces bolted on.

(*e*) Covers and drag ropes are rolled into a bundle and lashed into the central opening of the shield.

12. To uncrate—gun and carriage

(i) Unstrap and remove the spare parts box and tool box from the trail. These are readily accessible.

(ii) Remove the lid of the wooden packing case mounted at the trail eye end of the crate and empty the case of the stores carried in the case.

(iii) Remove the battens to which gun covers and parallelscopes are secured. Remove parallelscopes and stands.

(iv) Remove shovels, helves pick, aiming posts and cut off actuating rod.

(v) Remove pickaxe heads and shield stays from cross stays 3/15.

(vi) Unbolt bars securing wheel hubs and remove wheel hubs, hub packing piece and packing piece over gun securing band.

(vii) Remove the nuts from the long retaining rods passing through cross stays 5/13 and 3/15.

(viii) Un-nut the U-brackets securing the axle to cross stays 5/13 and 3/15 and lower the axle on to the trail.

NOTE.—One end of the axle will rest on the left trunnion of the cradle. It is advisable to protect this trunnion with rag.

(ix) It is now necessary to dismantle the crate.

Remove the whole of the top structure with uprights numbered 1/2, 5/6, 7/8, 11/12, 13/14, 17/18, leaving in position the base of the crate, uprights 3/4, 15/16 and the cross stays 4/16, 6/14, 9/10.

The superstructure is secured to the base of the crate by angle brackets.

To remove the superstructure

(*a*) Upright 1/2–17/18, remove the nuts and bolts from the vertical arms of the base angle brackets.

(*b*) Upright 3/4–15/16, remove the lower two of the three upper bolts.

(*c*) Upright 5/6–13/14, remove the nuts from the two base bolts, remove the lowest one of the bolts in the vertical part of the lower angle bracket.

(*d*) Upright 7/8–11/12, remove the nuts from the two base bolts.

The superstructure of the crate can now be lifted and carried clear of the equipment.

(x) Remove the axle.

(xi) Remove the brake actuating rod from inside the trail.

(xii) Remove the clamping blocks at muzzle and breech.

(xiii) If a L.A.D. with lifting gear is available, arrange slings about the piece and cradle and lift the piece and cradle together clear of the trail.

(xiv) Lift the rear end of the trail and remove the wheels from under the trail.

(xv) Assemble the hubs, wheels, axle and brake gear.

(xvi) Lift the front end of the trail and run the axle into position, nut up axle securing bolts.

(xvii) Run trail clear of crate.

(xviii) Remove trunnion capsquares and lower cradle into position, replace and nut up the capsquares.

(xix) Reverse traversing gear hand wheel to operating position, mount intermediate cocking lever and firing mechanism.

(xx) Mount sighting and parallel motion gears.

(xxi) If no L.A.D. is available to lift gun and cradle then they must be lifted individually, using handspikes and slings as necessary.

(xxii) Remove gun securing band and the keys from the rear end of the piece.

(xxiii) Put a handspike in the muzzle and pass a sling under the breech end of the piece ; pass a handspike through the sling.

(xxiv) Ease the piece to the rear, i.e. breech leading, until the block can be lowered.

(xxv) Open the breech, insert a handspike and carry the piece clear.

(xxvi) Fit slings about the ends of the cradle, pass handspikes through the slings and lift the cradle clear.

(xxvii) Now proceed as in paras. xiv, xv, xvi, xvii and xviii.

(xxviii) Mount the piece on the cradle and replace locking keys and gun securing band.

(xxix) Reverse traversing hand wheel to operating position.

(xxx) Mount sighting and parallel motion gears.

To uncrate—platform and shield

(i) Remove covers and dragropes from the crate.

(ii) Remove screws securing bracket spare parts box and brackets securing No. 7 dial sight case.

(iii) Remove bolts from the four uprights of the shield and platform crate.

(iv) Remove shield and platform from crate and mount them on the equipment.

DIMENSIONS AND PARTICULARS FOR STOWAGE

Crate, main (including Box, sight gear)

Length	Width	Depth	Weight	Cub. capacity
11 ft. 0½ in.	4 ft. 4¼ in.	3 ft. 0 in.	1 ton 18 cwt.	143·5 cub. ft.

Crate, shield and firing platform

Length	Width	Depth	Weight	Cub. capacity
6 ft. 4 in.	4 ft. 5 in.	1 ft. 5 in.	4 cwt.	39·75 cub. ft.

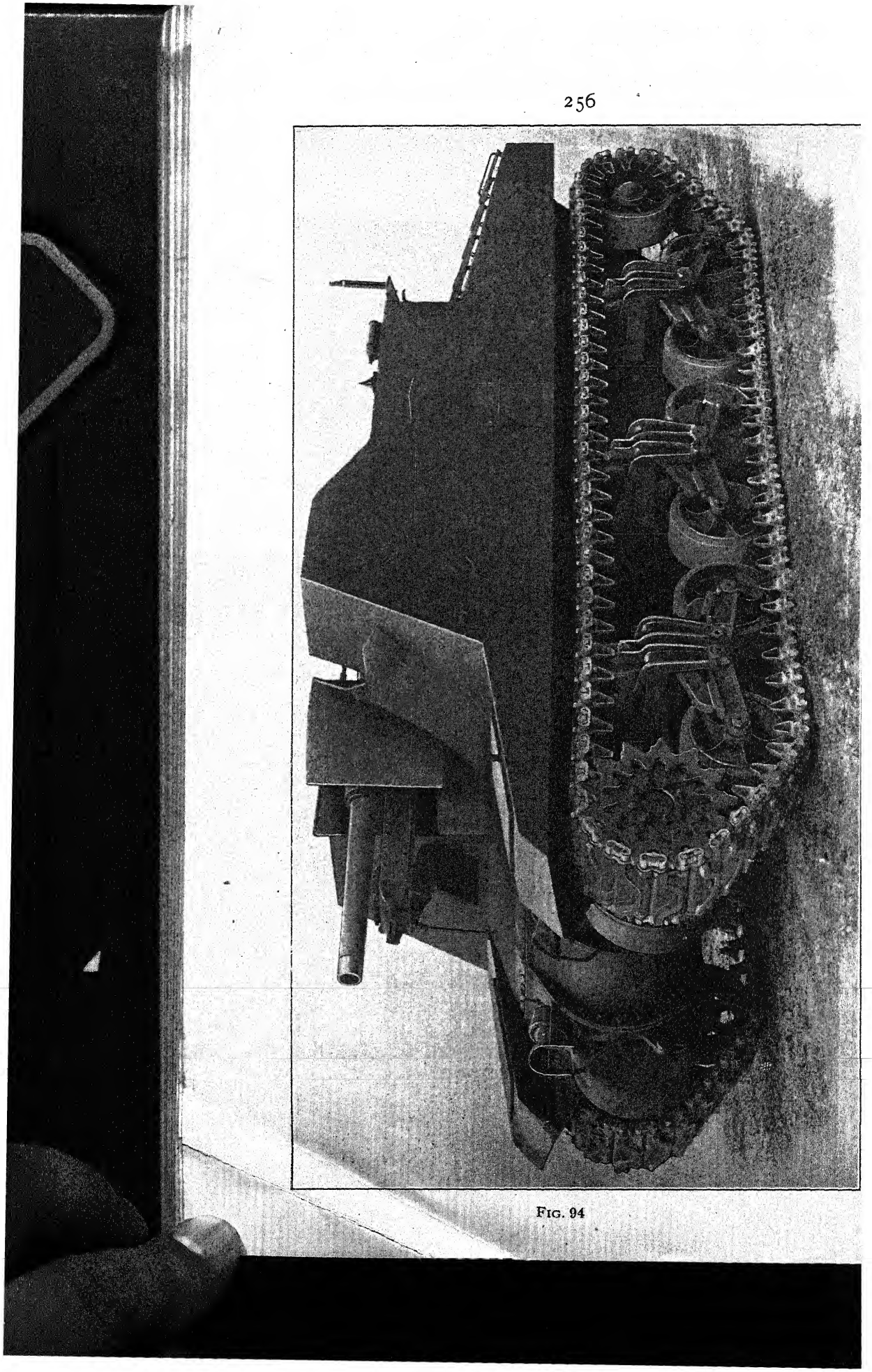


FIG. 94

CHAPTER IX

ORDNANCE, S.P. 25-PR., C MARK II

IN

MOUNTING, S.P. 25-PR., C MARK I

ON

CARRIER, RAM, S.P. 25-PR., MARK I

DESCRIPTION

The equipment consists of a 25-pr. field gun mounted in the fighting compartment of a Ram tank chassis. The majority of the parts comprising the gun and mounting are identical with those of the wheeled equipment. The main differences are dealt with in the succeeding paragraphs.

The **saddle supporting bracket** (Fig. 95) is in the form of a T-shaped bolster welded to and forming part of the carrier. The stem of the T is displaced 6 inches to the left of the centre line of the vehicle, leaving room for the driver's compartment on the right. A bearing, bushed at the top and bottom, is provided in the stem to take the pintle of the saddle. The weight of the equipment is taken on the flange of the upper bush. Vertical movement is prevented by a nut and lock nut screwed to the lower end of the pintle and adjusted to bear lightly against a flange of the lower bush.

A traversing rack is secured to the left side of the bolster stem and a cradle clamp is hinged in brackets on the upper side. A traversing indicator scale is located between the cradle clamp brackets.

The **saddle** (Fig. 95) has a pintle of large diameter which pivots in the bearing of the saddle supporting bracket. It can be traversed through 40 degrees, i.e. 15 degrees right and 25 degrees left.

Traverse is limited by a stop, bolted to the front face of the saddle transom, engaging stop lugs on the supporting bracket.

A traversing indicator reader is attached to the rear of the saddle to work in conjunction with the scale on the supporting bracket.

Trunnion bearings for the cradle are provided on the upper part of the saddle side frames.

A stop, on the rear sloping surface of the saddle transom, contacts the cradle and limits elevating to 40 degrees. A depression stop on the front of the transom contacts the cradle and limits depression to 9 degrees.

Two curved steel brackets, secured to the saddle in front of the trunnion bearings, carry curved ½-inch armour shields.

Extensions of the left side frame of the saddle are prepared to take the elevating gear and the sight supporting bracket.

A layer's seat extends to the rear from this point and traverses with the gun.

The **traversing gear** (Fig. 96) is bolted to the left side frame of the saddle and comprises a hand wheel with shaft, worm, worm wheel, rack pinion shaft and rack pinion.

The traversing rack is secured to the saddle supporting bracket. The hand wheel shaft with worm is carried in three ball bearings and the rack pinion shaft is carried in two bearings. The latter are supported in an eccentric sleeve which can be rotated to adjust backlash between the worm and worm wheel. The complete traversing gear assembly is adjustable horizontally on a machined pad on the side frame of the saddle.

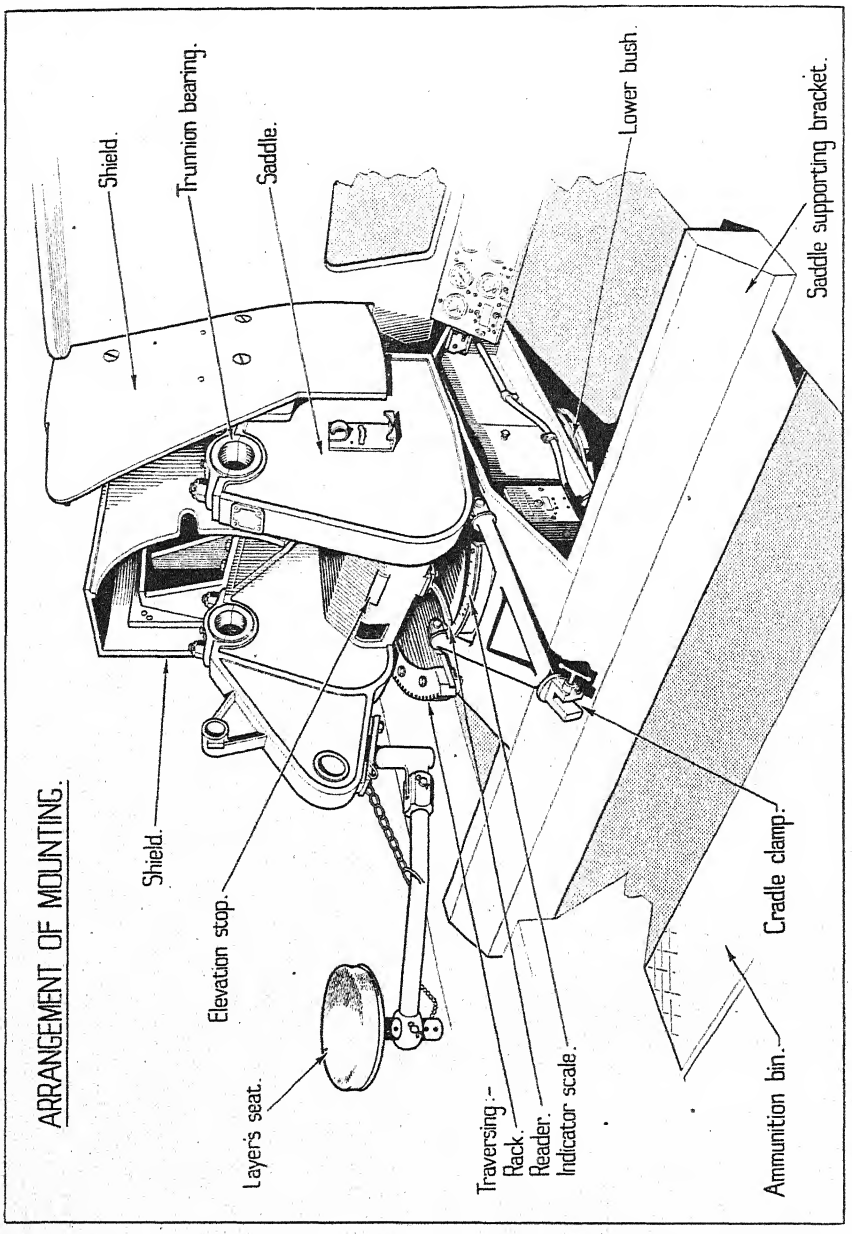


FIG. 95

The **cradle** is fitted with a bracket on the right just in rear of the front cap, to carry the recoil adjusting gear, and a bracket to engage the cradle clamp is fitted on the under side at the rear.

The **recoil adjusting gear** (Fig. 97) consists of a short, screw-threaded rod with forked end and two nuts. The forked end is pinned to the actuating lever of the cut-off gear segments and the nuts are on either side of an angle piece of the recoil adjusting gear bracket, through which the screw-threaded rod passes. The length of recoil required can thus be set and the gear locked.

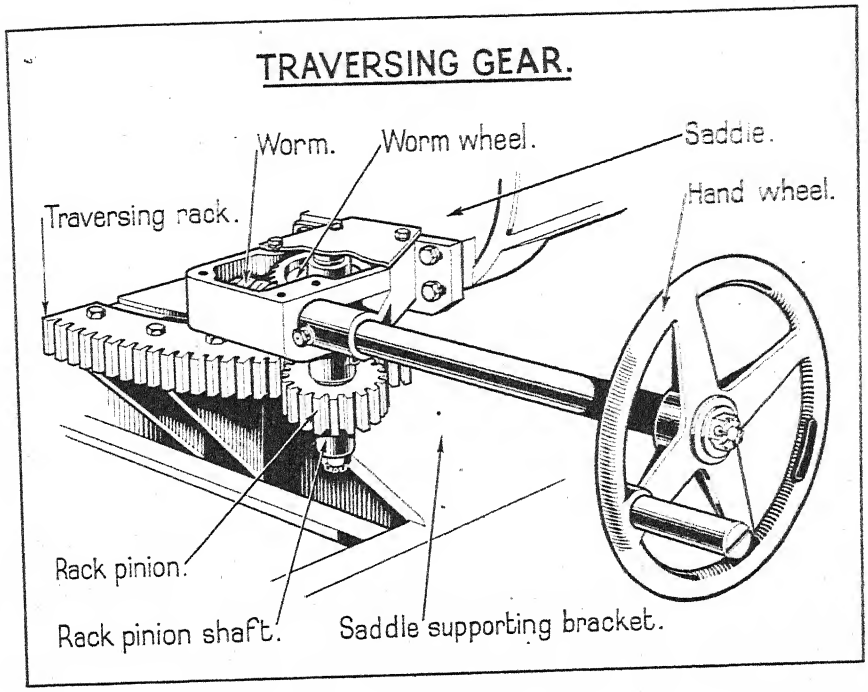


FIG. 96

With this equipment the length of recoil must never be allowed to exceed 20 inches in order to ensure adequate clearance at all times. An easy method is provided to determine if the length of recoil is being kept within this limit.

As the piece recoils, black, white and red painted stripes 1 inch wide are disclosed on the right and top right side of the recoil block. The length is indicated by the colour of the stripe which appears at the rear end of the saddle as follows :—

Black indicating 18 inches to 19 inches recoil.
White indicating 19 inches to 20 inches recoil.
Red indicating 20 inches to 21 inches recoil.

The red stripes should not appear.

The **ammunition** for the gun is carried in bins at the rear and under the floor plates of the fighting compartment and consists of :—

112 cartridges.
87 H.E. and/or smoke projectiles.
18 A.P. projectiles.

A **No. 19 wireless set** is housed in the left rear corner of the fighting compartment and provides for intercommunication as well as transmitting and receiving.

The **sighting gear** is identical with that used on the Mark I field carriage and similar tests will be applied, except as follows :—

To test and adjust the range scale gear.
To test and adjust the No. 41 telescope.

Details of these two tests will be published later.

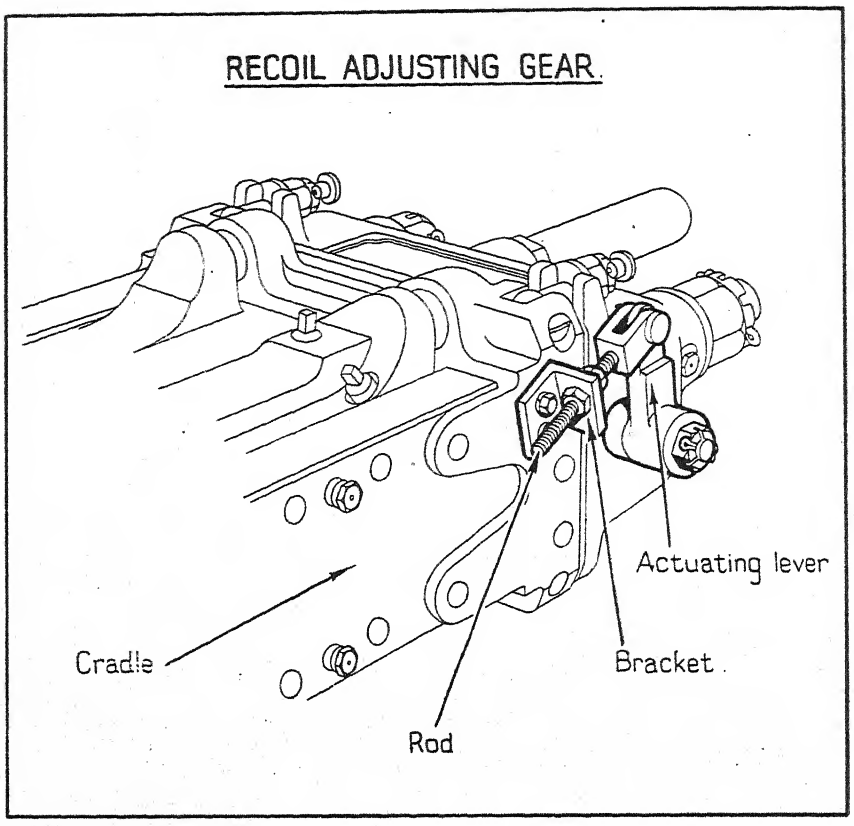


FIG. 97

MISCELLANEOUS DATA

Depression (maximum)	9 degrees.
Dimensions, complete equipment—	
Length (maximum)	19 ft. 3 in.
Width	8 ft. 11 in.
Height	9 ft. 5 in.
Track centres	6 ft. 11 in.
Width of tracks	1 ft. 4 in.
Ground clearance	1 ft. 5 in.
Elevation (maximum)	40 degrees
Recoil (must not exceed)	20 in.
Traverse—	
Left	25 degrees
Right	15 degrees
Weight fully equipped (approx.)	25 ton 8 cwt. 3 qr. 20 lb.

CHAPTER X

MOUNTING, VALENTINE, 25-PR. GUN, MARK I

ON

CARRIER, VALENTINE, 25-PR. GUN, MARK I

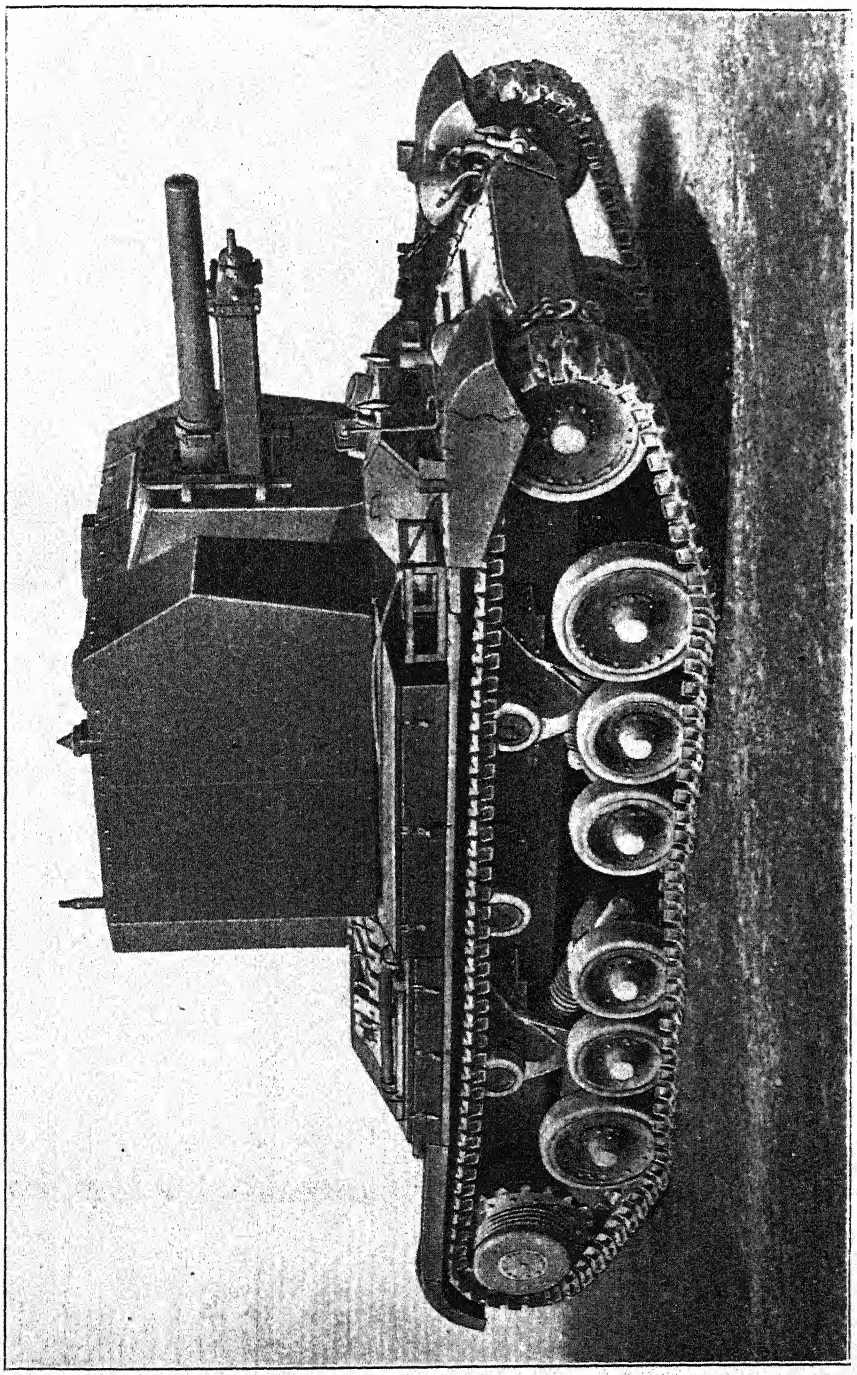


FIG. 98

DESCRIPTION

This equipment consists of a 25-pr. field gun in a mounting, that is contained in a shield forming a fixed turret on the upper surface of the hull of a Valentine tank. The ammunition, and all components required for the service of the weapon, are conveniently stowed inside the turret, so that the complete equipment is self-propelled and self-contained.

MOUNTING

The mounting can be traversed for 4 degrees on each side of the centre and elevated from a depression angle of 5 degrees to 15½ degrees of elevation. The gun can be fired up to a maximum elevation of 15 degrees. The mounting consists principally of a saddle supporting bracket, a saddle, the traversing, elevating and firing gears, the cradle containing the recoil cylinder which carries the gun, and the sights, all of which, with the exception of the saddle supporting bracket, are generally similar to those used on the Mark I field carriage. The main differences are described hereafter.

SADDLE SUPPORTING BRACKET

The **saddle supporting bracket** (Fig. 99) consists principally of two hollow side pieces, joined to each other by a saddle pivot bracket and a Z-shaped transom which are welded to the front, and near the rear end, respectively.

The saddle pivot bracket is in the form of a box transom, suitably shaped to give access to the nut securing the saddle to the bracket. It has a bushed vertical hole through the middle to receive the saddle pivot.

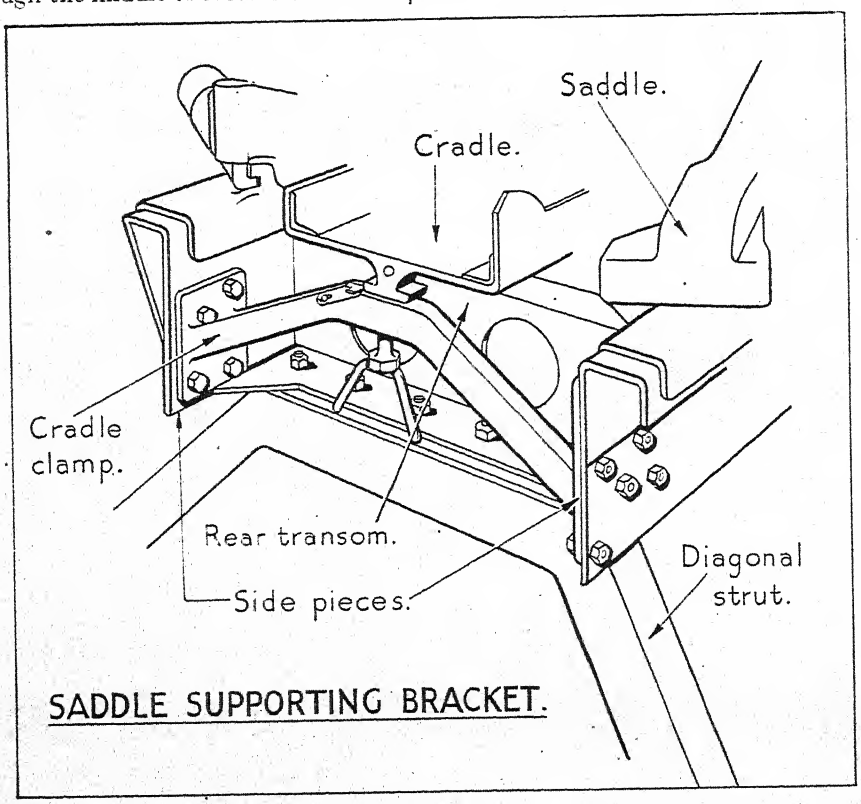


FIG. 99

The front portion of the saddle supporting bracket is secured to the upper surface of the carrier, a little in rear of the driver's compartment, with four bolts that pass through an inner extension of each side piece and the plating of the carrier. The

bolts are equally disposed to the right and left of the hole for the saddle pivot and are spot welded in position.

The rear transom is bolted and welded to a diagonal strut which is in turn connected to a lower transverse strut that is screwed to the side plates of the carrier hull. A gusset, interposed between the rear transom and the diagonal strut, is welded and bolted to both. It is also bolted to the inner extensions of the side pieces and welded on each side to one of the plates of the carrier, thus bracing the supporting bracket and also forming part of an upper deck on each side at the forward end of the gun house. Two large circular holes through the gusset give access to the keep pin and nut of the saddle pivot, while similar holes through the rear transom give access to the interior of the supporting bracket.

A brass bearing strip, to reduce friction between the saddle and its supporting bracket, is riveted to the upper surface of each side piece, the strips extending from near the front end to the position of the rear transom. A guide for the saddle clip, lined with bronze, is riveted near the rear end of each of the side pieces which are here stiffened internally. A bracket for the traversing gear pivot is secured to the left side piece below the position of the saddle pivot bracket.

CRADLE CLAMP

The **cradle clamp** secures the cradle to the saddle supporting bracket for travelling. It also serves as an elevation stop and consists of a diagonal stay that is bolted to the inner surface of each side piece of the saddle supporting bracket in rear of the brackets for the saddle clips. The clamp is provided with a pivoted locating piece and a screw with a wing head. The latter screws into a toe projecting downward from the rear end of the cradle when the gun is at an angle of 15½ degrees of elevation.

CRADLE

The **cradle** differs in the following minor particulars from those fitted to field carriages. The locking toe for the cradle clamp is screw-threaded internally, while the recoil strip, which on this equipment is graduated in inches from 10 to 24, is attached to the upper surface of the right guide. The recoil system has no cut-off gear and the front cap is therefore of a slightly different design. A 30-lb. counterweight of cast-iron is attached to the cradle, in front of the cradle clamp, to compensate for the weight of the front mantlet shield.

RECOIL SYSTEM

The **recoil system** is similar to that of the field carriage. The normal working recoil with this equipment should not exceed 19 inches. There is no need to investigate short recoils unless they fall below 16 inches.

SHIELD

The **shield**, of armour plate, forms the turret of the carrier and totally encloses the equipment and the gun detachment, with the exception of the major portion of the cradle, and the chase of the gun which protrude to the front through a port.

The main body of the structure is formed of the front and side plates which are welded together and form one piece. This portion is bolted to the top of the carrier hull, from inside the turret, through the medium of angle pieces at the front, a channel plate at the rear, and bottom plates and joint strips at the sides; the bottom plates forming inner extensions at the bottom of the shield.

The shield is provided at the rear with a large door in halves which can be closed and secured from inside or outside the turret, and can also be fastened in the open position. The left half of the door is provided externally with a container carrying five water cans, the cans being secured with straps. The front of the shield has three apertures which form ports for the gun and cradle, the sighting telescope, and the dial sight.

The gun and cradle port is so dimensioned that the gun can be elevated and traversed to the full extent permitted. This port is closed with a mantlet shield that is positioned by four guide brackets on the front exterior of the main body. It is supported on the cradle, by which it is raised as the gun is elevated. It lowers under its own weight as the gun is depressed and moves with the cradle when the gun is traversed, so covering the port at all angles of elevation and traverse.

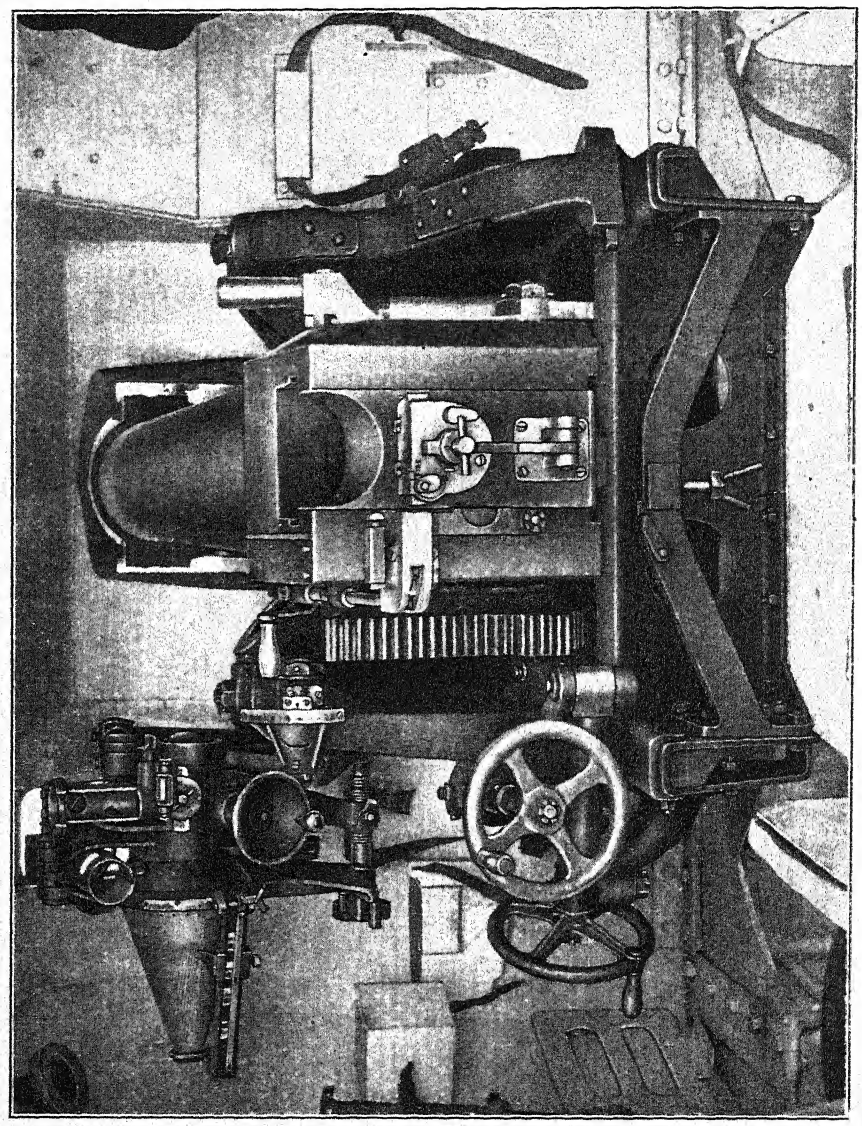


FIG. 100

The telescope sighting port is on the left of the gun port. It is closed by an inner sliding shield which can be secured in the open and closed positions by means of a T-handled screw.

Above the telescope port is a rectangular aperture for the dial sight, which is closed with an outer hinged shield. This shield is provided with a quadrant and a wing bolt so that the extent of the aperture may be varied as required.

The roof of the shield is bolted to angle plates that are riveted to the interior of the main body near the top, the nuts, with spring washers, being inside the turret. An angle plate is riveted close to the rear edge of the roof to form an upper stop for the halves of the door when closed. A large rectangular aperture in the left half of the roof, near the front, is closed with an external sliding door. This door is provided with four rollers, to facilitate movement, and can be secured in the open or closed position by means of spring-loaded catches affixed to the inside surface of the roof. An extension piece for the sight carrier is provided with the equipment in order that the dial sight may be used through the roof aperture. Two large circular holes are provided through the roof in rear of the large aperture, to receive an electrically-operated extracting fan, for ventilating the turret, and a No. 3 tank periscope. The former is a little left of the middle line and the other on the right of it and nearer the front. The roof is further prepared near the right side to receive the " A " and " B " aerials of the wireless set, and has a sighting vane mounted externally in front of the periscope.

Various fittings, for the carriage of the following items, are secured to the inner surface of the shield. Sighting telescope, dial sight, field and sight clinometers, sight illuminating apparatus, spare prisms for commander's periscope, dial sight extension piece, piasaba and wool cleaners, zero line reading plate, tool box, radio set and connected stores, fuze key, breech, gears, muzzle and sight covers.

A base plate, for the air pump used in conjunction with the recuperator, is secured to the upper surface of the carrier immediately in rear of the turret doors, brackets for the aiming posts are provided on the left side of the carrier outside the turret, while a bracket for a tetrachloride extinguisher is secured to the inner surface of the left half door.

The **ammunition** for the gun, consisting of 32 complete rounds, is carried in various fixtures which are conveniently disposed about the interior of the turret. Attached to the inner surface of the shield on the left side are two projectile bins, the upper containing eleven A.P. shot and the lower eight H.E. shell. In rear of these are two further bins, one above the other, each containing five cartridges. The upper projectile bin carries a grab handle for the convenience of the detachment, while brackets for the rammer are provided on the cartridge bins.

A bin containing 13 H.E. shell is situated immediately below the wireless set on the right side and in rear of this bin are two other bins, one above the other, each containing three cartridges. In front of the upper of these is still another bin, containing four cartridges, to which a grab handle is affixed similar to that on the left side. A triangular box, with a hinged lid, containing 24 ether starting capsules, is welded to the projectile bin on this side. The remaining 12 cartridges are contained in a metal box, having a removable lid, which is secured to the floor of the turret immediately in the rear of the breech of the gun. All of the cartridge containers are provided with felt packing pieces resembling large washers, one packing piece for each cartridge.

A metal platform, or gunner's deck, is situated on each side of the cartridge box. These platforms are at a higher level than the lid of the box and are secured to the carrier through the medium of stays and brackets. The spare parts box is secured with straps to the upper surface of the right platform, and on the right of the box are a pair of rifle clips. Underneath this platform are two metal containers, each provided with strap fastenings, one to receive the first aid cabinet and the other which is divided into two compartments, to contain haversacks.

Two tip-up, leather-covered seats, each provided with a leg-guard, are situated just inside the turret door, one above each of the gunner's decks. Leather-covered pads are secured to the roof and half doors immediately above and in rear of the seats.

The seat on the right, for the gun commander, is adjacent to the periscope, which has a white bearing ring that is graduated in degrees from 0 to 360, the 10 degree lines being in RED and the remaining markings in BLACK. The periscope provides an all-round field of view, can be freely turned and rotated vertically, and is provided with two clamping screws to lock it at any bearing and attainable angle of elevation. It is provided with lubricators, carries a bracket to receive the hand microphone attached to the headgear receiver of the wireless set, and has a radio control box in its immediate vicinity.

The seat on the left, for the loader, is situated in rear of a chair for the gun layer, which has a leather-covered seat and back-rest. This chair pivots in a bracket bolted to the hull, can be turned, adjusted for height, and clamped in the desired position.

A removable chute is fitted immediately in rear of the breech, and above the cartridge box, at a suitable angle to convey the ejected cartridge case into the lowest part of the turret, in rear of the driving compartment. (The chute can be lowered and stowed clear of the breech when the gun is in the travelling position.)

A festoon electric lamp is provided near the front on each side of the turret. These lamps have individual switches and are controlled by a master switch on the left side in the driver's compartment of the carrier.

SIGHTING

The sighting gear is identical with that used on the Mark I carriage and, with the following exceptions, the same tests and adjustments are applicable.

Test 5 (*a*) is to be done at an elevation of 10 degrees, and the procedure detailed in sub-paragraphs (*j*) and (*k*) should be modified to that extent.

Test 5 (*b*) is to be complied with from (*a*) to (*e*) inclusive, the remainder of the procedure being disregarded. If the error with the gun layed at 10 degrees of elevation exceeds 5 minutes, the sight must be adjusted by an artificer.

The sight testing target, for use with this equipment, is depicted in Fig. 101.

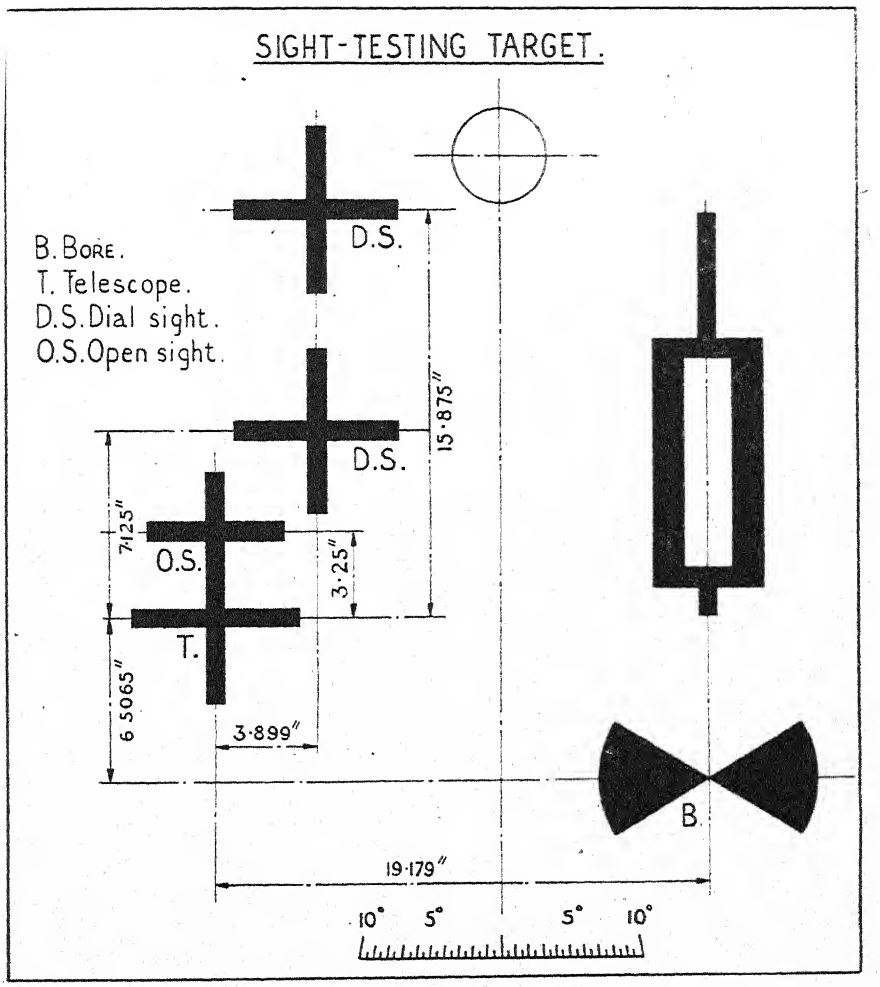

SIGHT-TESTING TARGET.
B. Bore.
T. Telescope.
D.S. Dial sight.
O.S. Open sight.
D.S.
D.S.
O.S.
T.
B.
15·875″
7·125″
3·25″
6·5065″
3·899″
19·179″
10°
5°
5°
10°

Fig. 101

MISCELLANEOUS DATA

Complete equipment—

Depression—maximum angle obtainable with carrier horizontal	5 degrees.
Dimensions—	
Height from ground level to—	
Centre of trunnions	6 ft. 6·175 in.
Top of shield, aerial protection block	9 ft. 0·75 in.
Length overall	18 ft. 2 in.
Width—	
Shield	6 ft. 6 in.
Overall	8 ft. 7·5 in.
Shipping	1,420 cu. ft.
Elevation—maximum angle obtainable with carrier horizontal—	
Firing	15 degrees.
Travelling	15·5 degrees.
Trunnion pull	9 tons.
Weight—	
Laden, without crew	17 tons 3 cwt. 1 qr. 8 lb.
Shipping	35 tons 20 cu. ft.

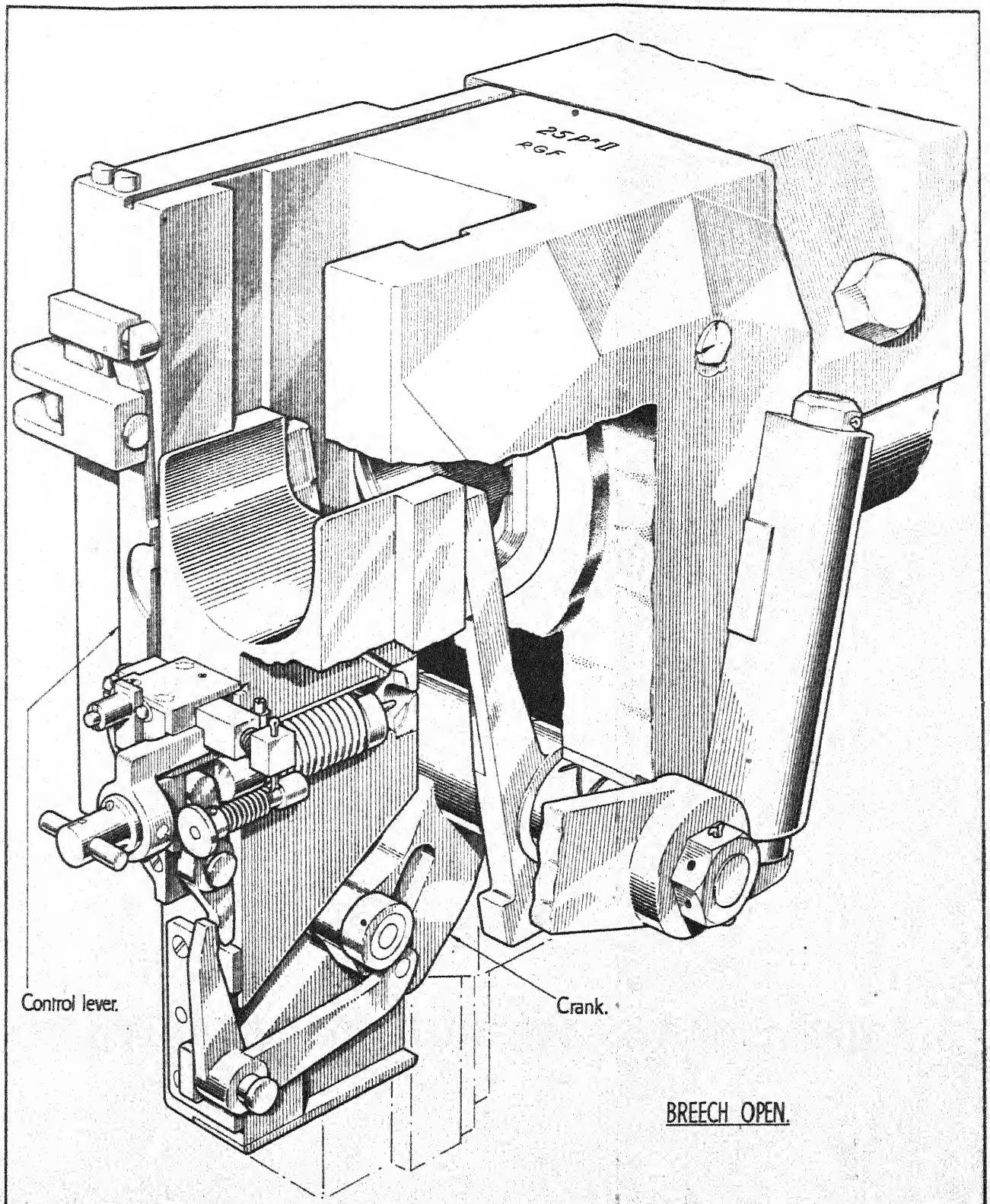
Carrier and turret (without gun)—

Dimensions—shipping	796 cu. ft.

Mounting—

Recoil—	
Normal working—maximum	20 in.
Minimum at which investigation of cause is necessary	16 in.
Traverse—	
Left of a centre line	4 degrees.
Right of a centre line	4 degrees.
Total	8 degrees.

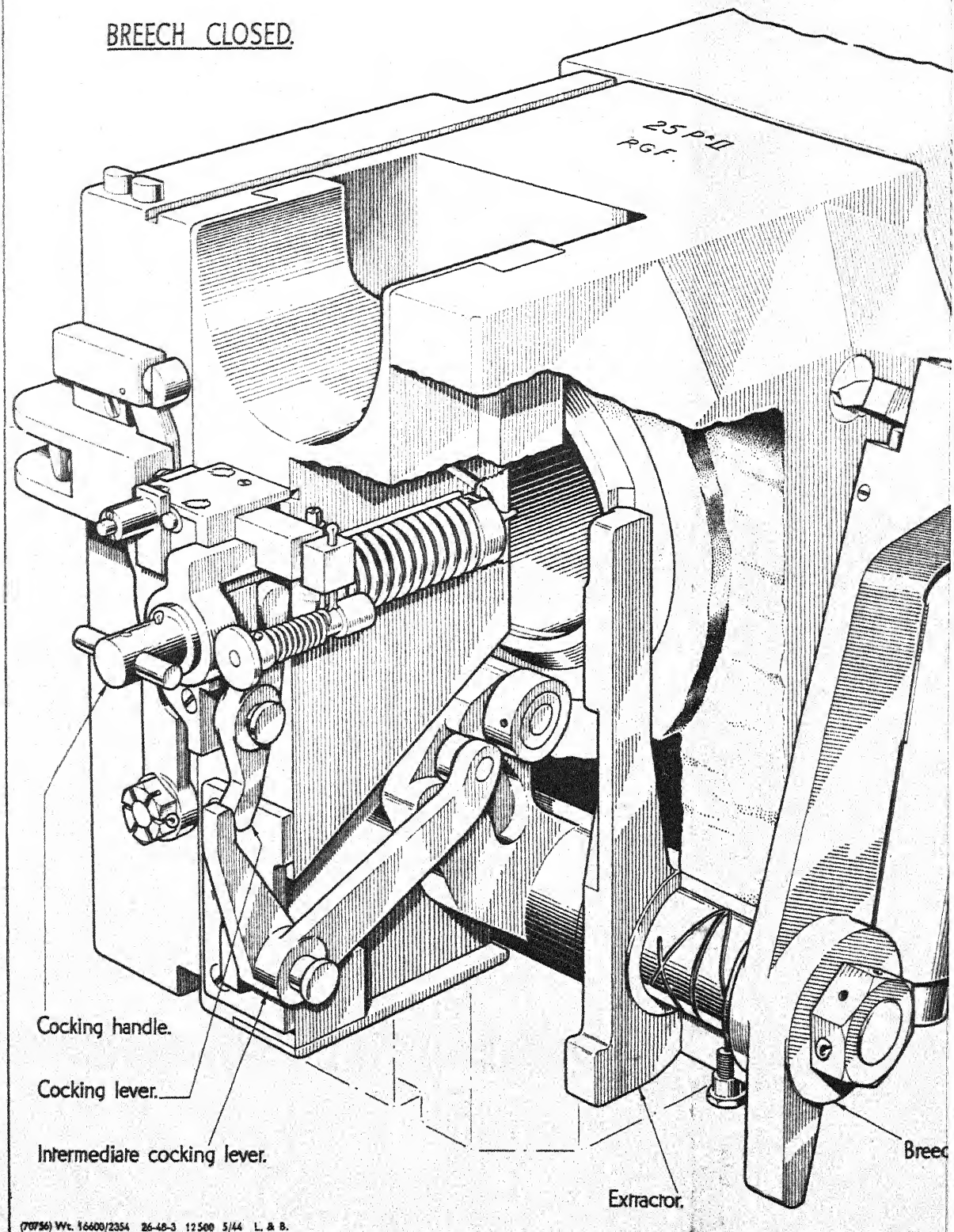
(3405.) 70749. Wt. 16600–2254. 12,500 10/44. A., P. & S., Ltd. 428.



BREECH OPEN.

(70756) Wt. 16608/2354 26-48-3 12500 5/44 L. & S.

BREECH CLOSED.



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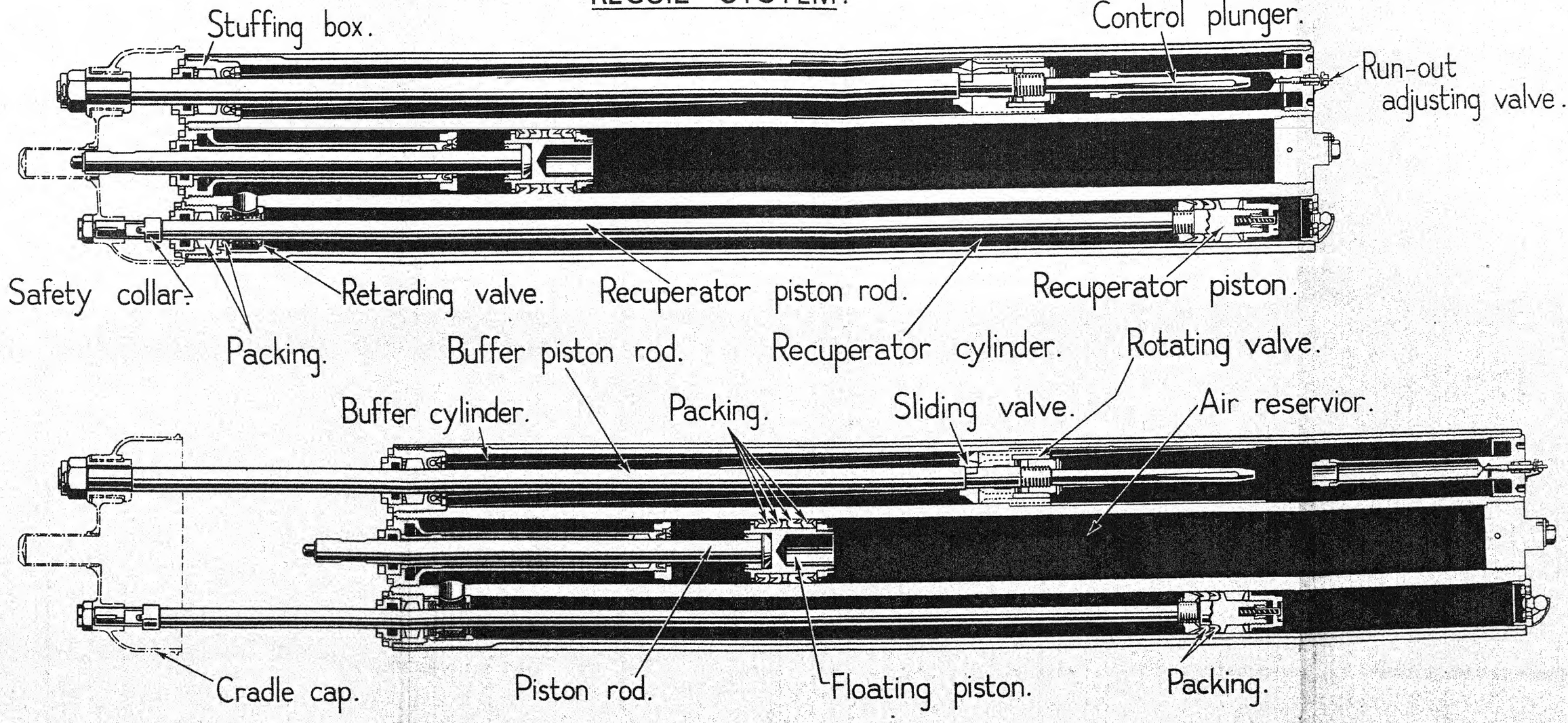
RECOIL SYSTEM.



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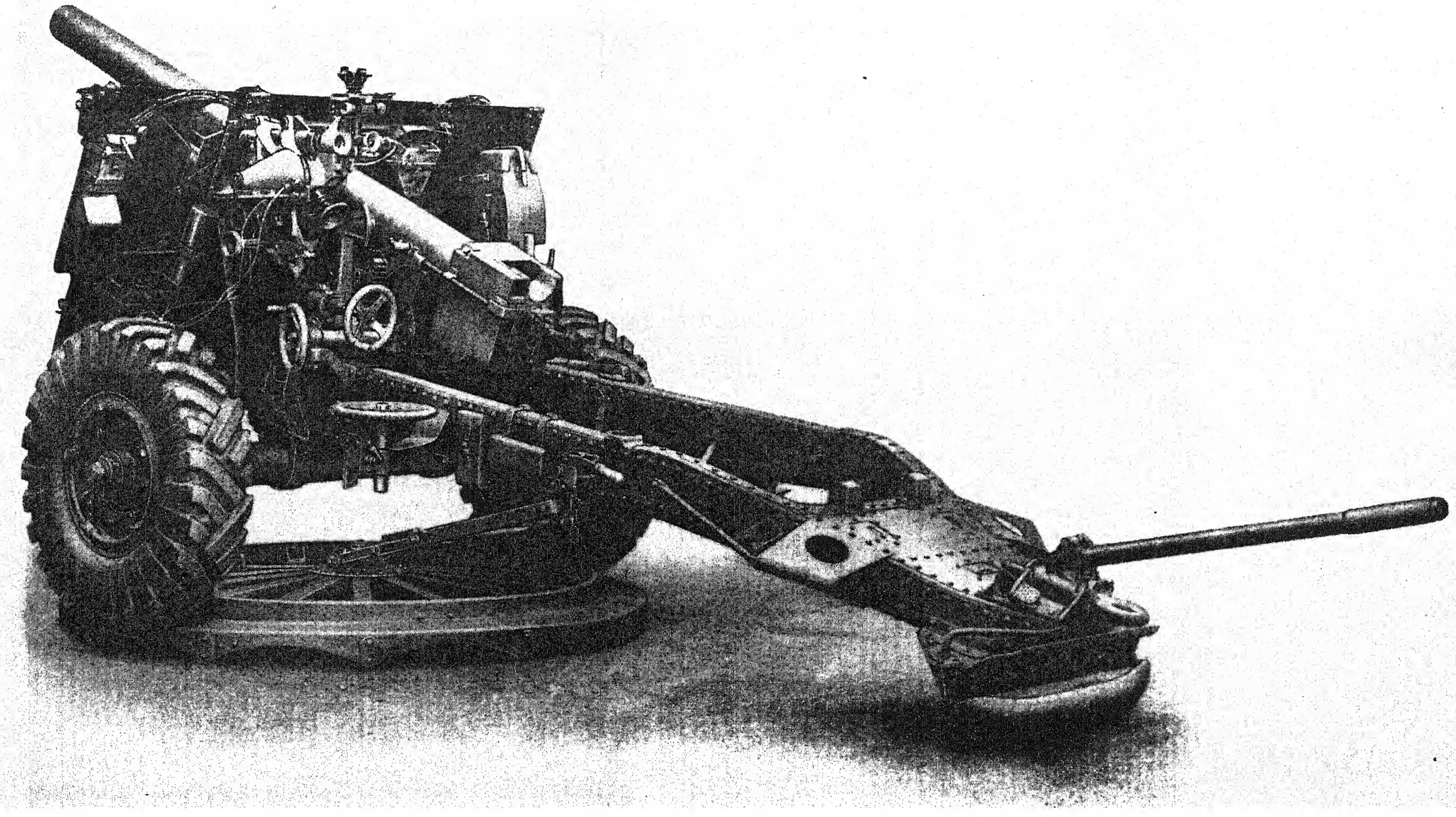
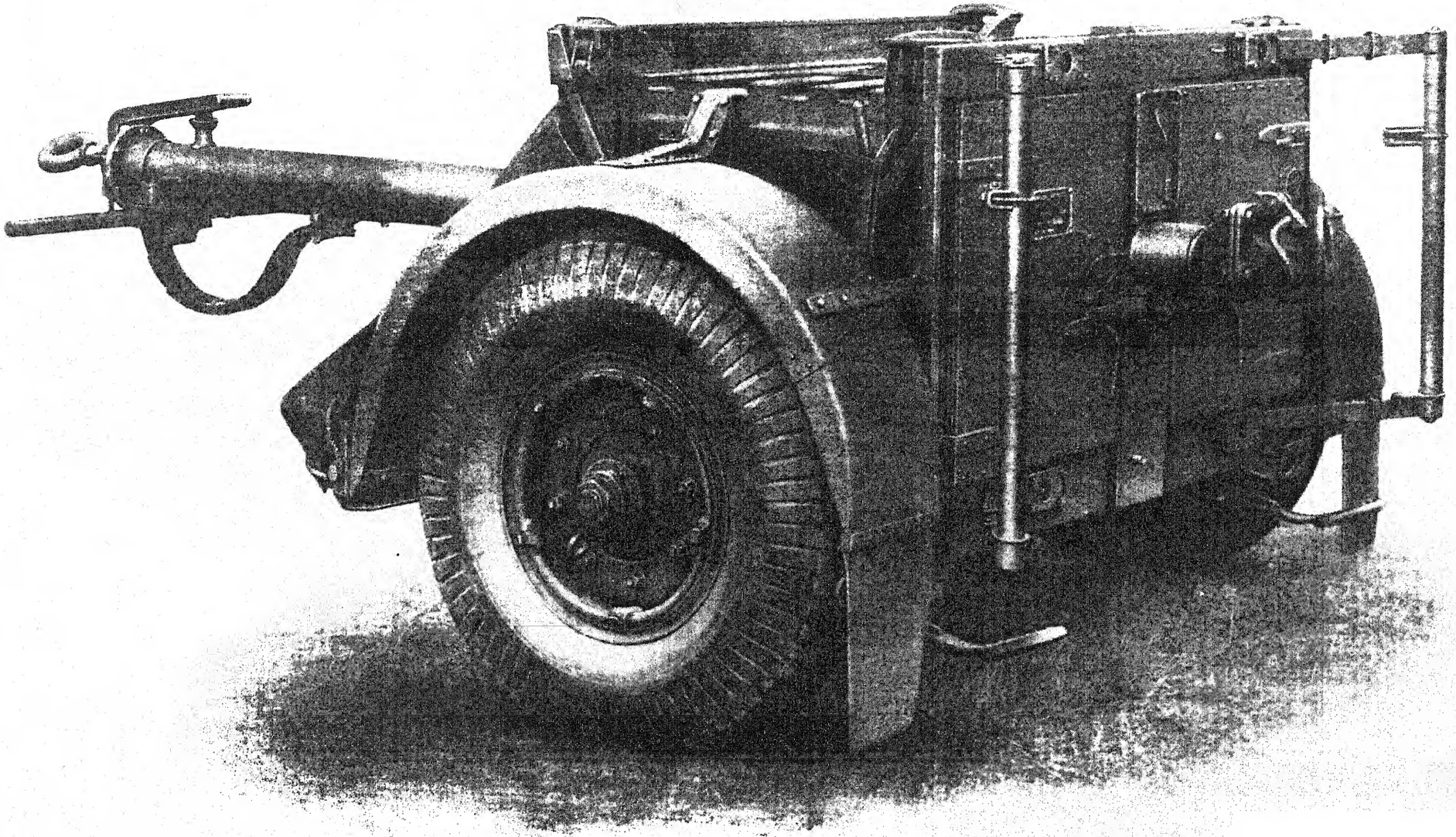
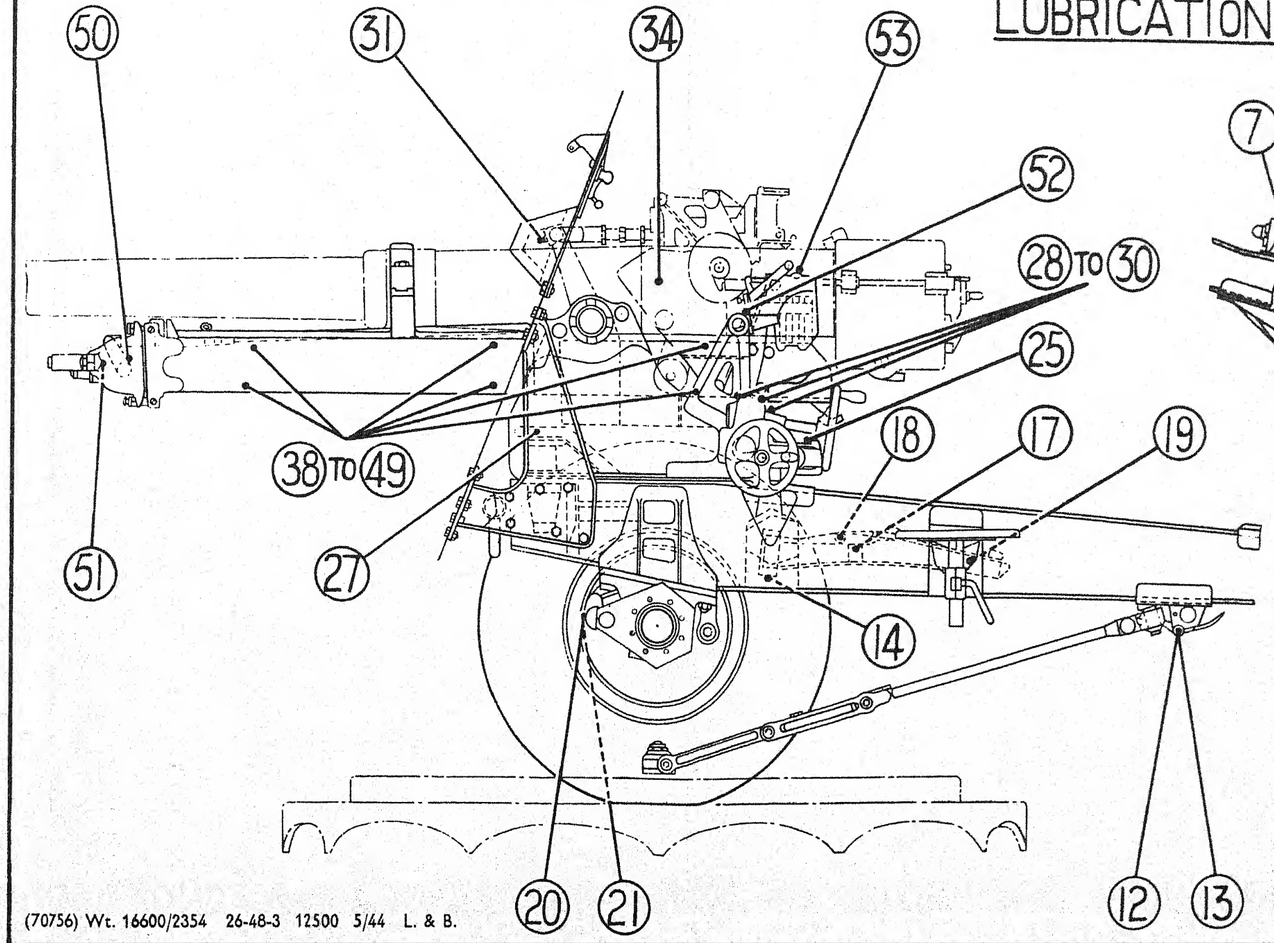
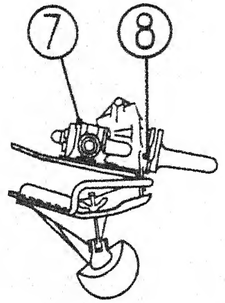


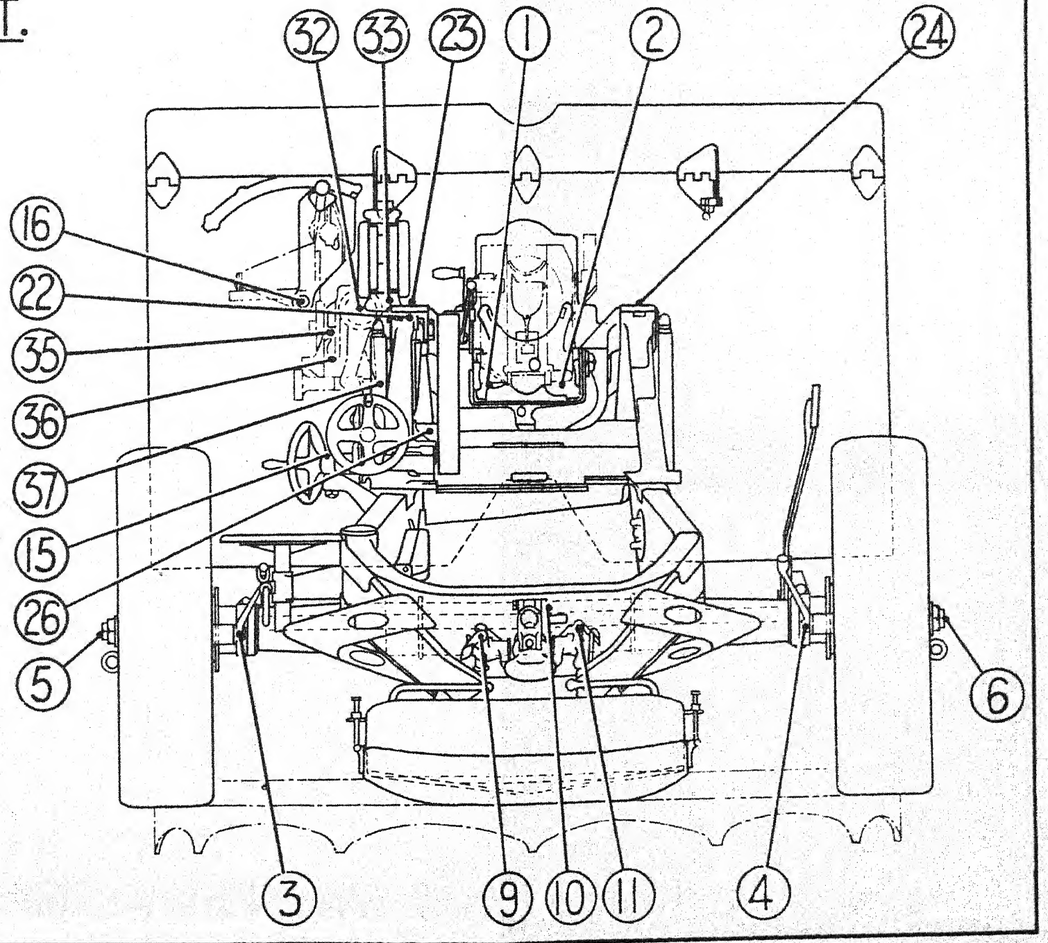
PLATE 5



LUBRICATION CHART.







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